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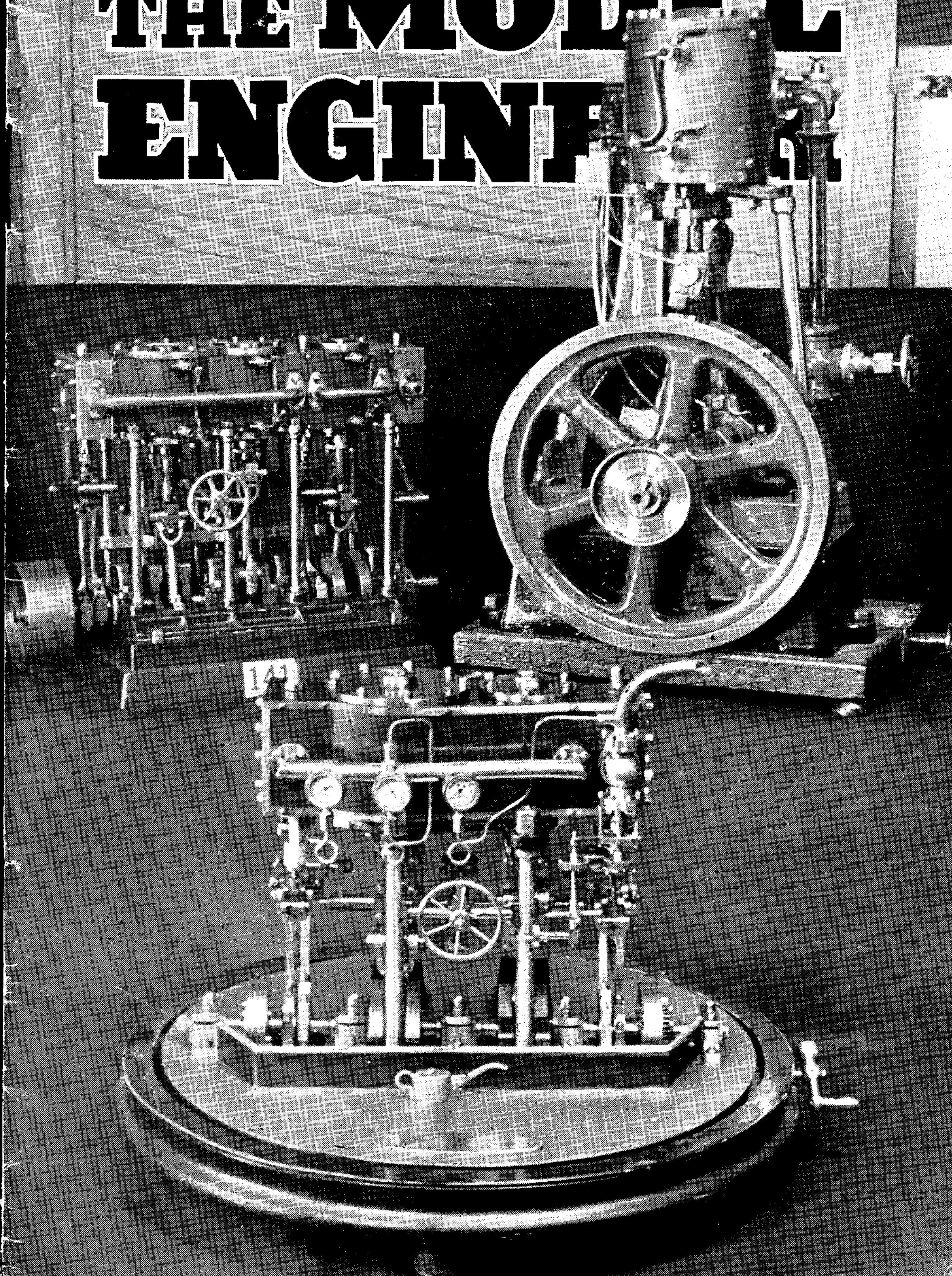
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

26TH APRIL 1951 VOL. 104 NO. 2605

SMOKE RINGS

Uncontrolled Enthusiasm

● WE HAVE often noted that there are some model engineers who have an unhappy knack of allowing enthusiasm to cloud their better judgment. For example, we know of one who is actively engaged in the construction of a 5-in. gauge replica of a 0-6-0 tank shunting locomotive of quite a well-known type, and we were rather staggered, the other day, to receive from him a letter in which he informed us of his intention to fit seven superheater elements to the boiler of his engine and, further, to adopt a working pressure of 150 lb. per sq. in. At first, we thought that some typing errors had been made, but upon our questioning the figures, we received confirmation of them ; so we then decided to advise him against such ideas.

However, it is our friend's engine and not ours ; so he is quite free to do what he likes with it, and we shall be very interested to learn the results obtained if he carries out his intentions. Yet we still have an uncomfortable feeling that here we have a clear case of misdirected enthusiasm. The engine is being built, we believe, as nearly as possible to scale ; therefore, the little boiler cannot be much above 5 in. in diameter in an engine of this type. About 25 fire-tubes of $\frac{7}{16}$ in. diameter would provide a reasonable amount of heating-surface without overcrowding ; but we would be prepared to provide two $\frac{3}{4}$-in. superheater flues and some twenty $\frac{7}{16}$-in. tubes in a boiler of this size.

We fully appreciate the value of superheated steam when it can be obtained, though we are very doubtful whether it is possible to obtain really *superheated* steam in a boiler so small as 5 in. diameter, on a working miniature locomotive. Be that as it may, however, we seriously question the advisability of providing seven superheater flues, if only because of the very severe reduction of ordinary heating-surface which would result from such an arrangement. The little boiler would be very hard pressed to provide any steam to superheat !

As to the 150-lb. pressure, we can only say that this will provide a very wide range in which to discover what pressure really suits the engine ; we should be surprised if it were much more than 90 lb. With the proposed $1\frac{1}{4}$-in. cylinders, the tractive effort developed at 150 lb. boiler pressure would be approximately 80 lb. Since the maximum adhesive weight would be little, if any, more than 200 lb., the results are obvious !

It has always been a fact that there is such a thing as too much of a grand idea, or good feature. No amount of "improvement" upon normal custom should ever be adopted without carefully calculating the results.

The Lighter Side

● WE READ the following story in a recent issue of the *Birmingham Dispatch*, and we think it is worth repeating.

A certain individual discovered that the flint in his cigarette lighter had become wedged. So he dismantled it, including the complicated arrangement of gears and springs, then found he could not put it all together again. He knew that the Nuneaton Model Engineering Society was holding an exhibition, and putting all the bits and pieces of his lighter into a box, he went along to the show. There the ligher was reassembled in less than ten minutes. Service!

The Andover Exhibition, 1951

● MR. R. PEMBLE tells us that the Andover and District M.E. Society, with the aid of the societies affiliated to the Southern Federation of Model Engineers, were able to put on their "best ever" exhibition at Easter. The exhibition was opened by Councillor S. E. Vincent, himself an engineer by trade, and he paid a great compliment to model engineers when he quoted: "The whole future of Great Britain depends on the skill and craftsmanship of its workers, and this society, by cultivating and building up this quality, is playing a great part in its future."

Two hundred models of ships, locomotives, road locomotives, stationary steam and i.c. engines and aircraft were on show, together with art and handicraft by local schools and womenfolk who are members of the society. Mr. Barrett's 7¼-in. gauge "Royal Scot" was giving all and sundry rides to and from the exhibition and the society's "OO" gauge railway was a great centre of attraction. Messrs. O. T. Wicks and George Crouch were fully occupied on the air line with 15 models punctuated by an occasional "burst" from an i.c. engine. Photographs of the club's activities over six years were also displayed and a special feature on the handicrafts stall was a stage depicting Festival of Britain 1851, with ten figures in period costume. This was displayed on behalf of the Playing Fields Fund and was the combined work of Lady Fetherston-Godley, Mrs. Beattie Halford and Mrs. Kemp.

Thanks are due to Salisbury, Basingstoke, Newbury, Chichester, Fareham, Southampton, Isle of Wight, Totton and New Forest, and Lymington for a grand contribution of models and transport, and a special "thank you" to Reading and Trowbridge who patronised the show for the first time.

It was particularly gratifying to meet visitors from all over the country, and that short chat and handshake was well worth the hard work organising the event.

Even Homer Will Nod Sometimes

● A WELL-KNOWN model engineer, a man with considerable workshop experience, had a number of very small holes to drill in some work that he had in hand. No. 80 drills certainly require more than a little care and just the right "feel" if the best results are to be achieved; but try as he would, our friend had no success. His drilling-machine was of a famous type that is usually beyond reproach, yet drill after drill broke within a few seconds of the feed being applied.

This, of course, was exasperating and it looked as though that drilling-machine would have to go back to the makers. However, another well-known model engineering personality called in at just the right moment and heard the sad story. He looked the machine over and could see nothing wrong with it; so a drill was inserted in the chuck and the machine was started up, only to cause the visitor to exclaim: "Hi! What's all this? Whose leg are you trying to pull?"

Our friend replied: "I assure you I am trying to pull nobody's leg. All I want is to be able to drill small holes." Said the visitor: "Then why are you running the darn things backwards!"

This story is perfectly true.

Abergavenny Hobbies Exhibition

● WE ARE pleased to learn that as a result of the paragraph in a recent issue of THE MODEL ENGINEER, drawing attention to the hobbies exhibition held during Easter week at the Drill Hall, Abergavenny, some excellent models were received from Mr. A. K. Pope, of Cinderford. Three of these had received diplomas at the London "M.E." Exhibition.

Many other excellent models were on view and the exhibition proved a resounding success. 4,231 people visited the hall during the five days it was open—1,376 attending on the last day.

The model railway, constructed by G. Manuel assisted by E. Powell and D. Griffiths, proved a great attraction, and 3,001 passengers paid for trips. The engines used were "Doris" and "Iris" models owned by F. Wilson, Sebastopol; "Juliet" by G. Wilson, Cwmbran; saddle tank engine by G. Manuel, Abergavenny; and works tank engine by E. Powell, Abergavenny.

Many model engineers from neighbouring towns visited the show, and all were very complimentary concerning the staging arrangements and quality of the exhibits.

Mr. John Curtis

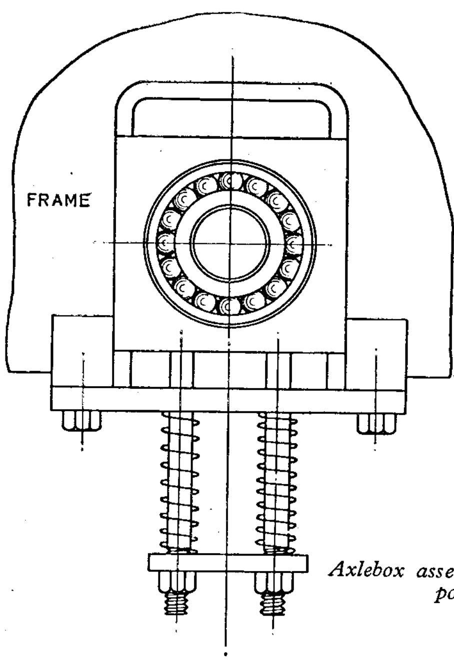
● THE NEWTON Abbot and District Model Engineering Society has sustained a sad loss by the sudden and unexpected death of Mr. John Curtis, which occurred during the evening of March 30th.

Mr. Curtis was a long-standing friend of all the members, a founder of the society and did a great deal of work towards making it a success, especially during the early stages of its formation. He was ever ready with help and advice for a fellow-member who had encountered any difficulty on a job in hand. Abhoring emery-cloth, he was a stickler for good, accurate workmanship and tool finish, and he always preferred to be original rather than copy designs by other people. He was "Chief Mechanical Engineer" to the club, and was the leading light of the team engaged on the club's locomotive, which embodied several unusual details. It has been decided that this engine, when it is finished, shall be named *John Curtis*, as a tribute to his memory and all that he meant to his friends.

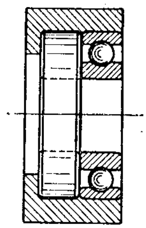
"Britannia" in $3\frac{1}{2}$-in. Gauge

by "L.B.S.C."

BUILDERS of the little lion-and-wheel-brand job have the choice of two kinds of axle-boxes; either ball-bearings or plain bearings can be used. Big sister has Timken roller-bearings, but these are not available—at time of writing, anyway—in a size suitable for the little one; and as I mentioned before, home-made roller-bearings would probably be no better than good plain bearings, making them being a specialised job not exactly suited to amateur home-workshop skill or equipment. There are, however, plenty of ball-bearings available, of adequate size; and on my own engine I have quite an assortment. In each of the driving boxes, there are two double-row Hoffman bearings, which gives four rows of balls per journal; they are self-aligning. Each of the trailing boxes carries one Hoffman and one S.K.F. — "equal shares for all!" Each leading box has two Ransome and Marles bearings, so that the rolling friction of the coupled axleboxes should be exactly nil. Judging by the total absence of slackness in the coupled axleboxes of my other ball-bearing engine, *Fernanda*, *Britannia's* axleboxes will still be free from slack or knock, when I am driving the *Astral Belle*.



Axlebox assembly in running position



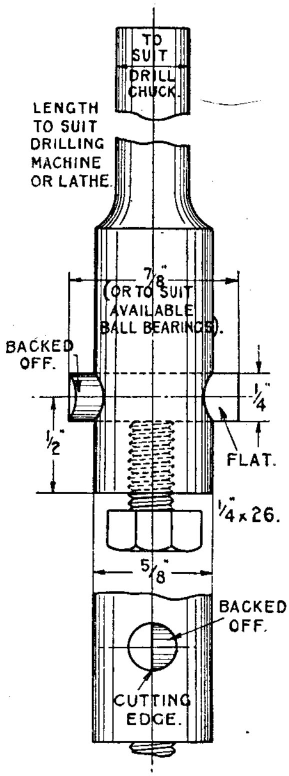
Section through ball-bearing main axlebox

The actual boxes are made to the same dimensions, whether ball or plain bearings are used; the spring-pins are the same, and the boxes are also fitted in the same manner. The boxes will also fit the cast type of hornblock, as specified for *Pamela* and other engines, the castings suitable for *Britannia* having wider jaws to accommodate the big boxes needed for the ball-bearings. A good quality bronze or gunmetal is desirable; and if our approved advertisers can supply the needful, the quality will be all right. Hard brass can also be used, either cast or drawn. Don't use ordinary commercial "screw-rod," except in emergency. Although it might be assumed that with ball-bearings, this would not matter, wear would take place at the sides, where the boxes rub on the hornblocks. In days gone by, when I did a few repair jobs for friends and acquaintances, I found that all badly-worn boxes were made of this material. Cast-iron boxes would do quite well, both for plain and ball-bearings. In the former case, the axles holes could be bronze-bushed; and the cast-iron boxes would slide easily in the horns without appreciable wear.

How to Machine the Boxes

If drawn bar material is used, a piece of $1\frac{3}{16}$ in. $\times$ $\frac{1}{2}$ in. section will be needed, approximately $7\frac{1}{2}$ in. long, which will allow for parting, and facing off each end. The outside will be smooth enough; but if cast bar is used, it will need cleaning up on the two wider sides. If a milling machine is available, mill the groove at each side before parting the boxes off the bar; cut it in two, if the travel of the miller table isn't sufficient to do the whole length at one fell swoop. If you have to do the job in the lathe, cut the bar into two or three pieces, according to the movement available on your cross-slide; the operation is done exactly as fully described for *Tich*, using a $\frac{3}{8}$-in. end-mill, or home-made slot drill in the three-jaw, and clamping the bar in the slide-rest tool holder, at the proper height. Warning—if the lathe is inclined to be a bit flimsy, as many home-workshop lathes unfortunately are, don't take too greedy a cut. According to Inspector Meticulous, the boxes should be machined to an exact sliding fit, easy but without endplay, in the horns. The best way to get it right, is to make a dummy hornblock, which can be tried over the embryo boxes whilst still on the machine. However, the wasp in the jampot is that all the horns are seldom exact to "mike" measure-

ments ; and your humble servant's advice is to machine the grooves just sufficiently to fit tightly in the horns, then saw or part the boxes off the bar, face off each end, to exact length, and fit each box separately, marking horns and boxes so that they can always be correctly replaced. To ease the grooves, lay a ⅜ in. square smooth



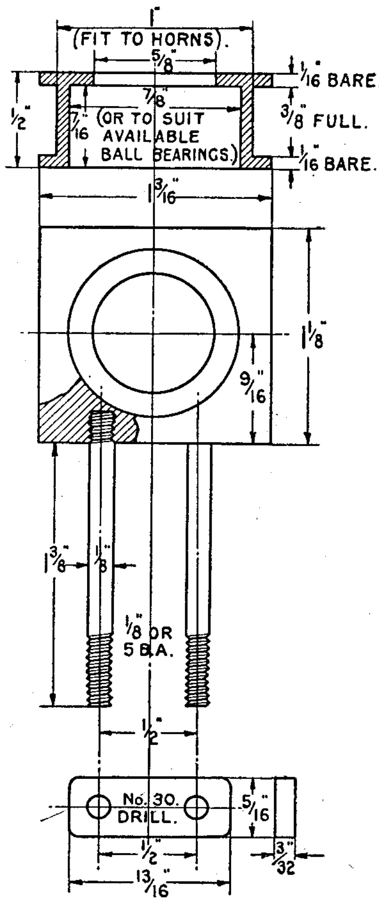
Recessing tool for ball-bearing axleboxes

file on the bench, and rub the boxes gently on it, groove downward.

Carefully centre the boxes for one side of the engine, and drill a $\frac{3}{16}$-in. or ¼-in. pilot hole right through ; if a good bench or pillar drilling-machine isn't available, chuck each box in the four-jaw, with the centre-pop running truly—easy enough if you bring up the tailstock, with a centre point in it, for a guide—use a centre-drill first, then the ordinary drill. Then follow procedure described in full for *Tich*, clamping each box to its opposite mate on the other side, and drilling the second box, with the drill guided by the hole in the first one. Try each pair in the frame, and put a piece of round rod through, to make certain the axle will be square with the frame. If " out," correct with a file, re-drill a little larger, and ditto repeato the trial until O.K. Then open out to ⅝ in. For this, I recommend using a pin-drill, which you can make yourself, as given in the *Tich* notes, and elsewhere. It doesn't matter if the hole is 1/64 in. or so larger or smaller, as it is only a clearance hole for that part of the axle between the ball-bearings and the wheel boss. If you propose to use plain bearings, open the holes to 31/64 in. only, then ream ½ in.

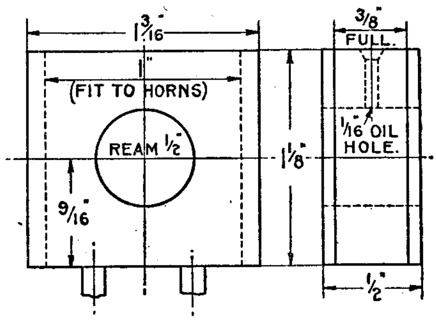
How to Recess Boxes for Ball-bearings

I recessed the axleboxes for my motley collection of ball-bearings, in the following easy way. Trust Curly to take the easy road ! Every bearing was exactly the same diameter, both inside and outside, and precisely the same width ; a few minutes with a " mike " soon confirmed that.



Main axlebox for ball-bearings

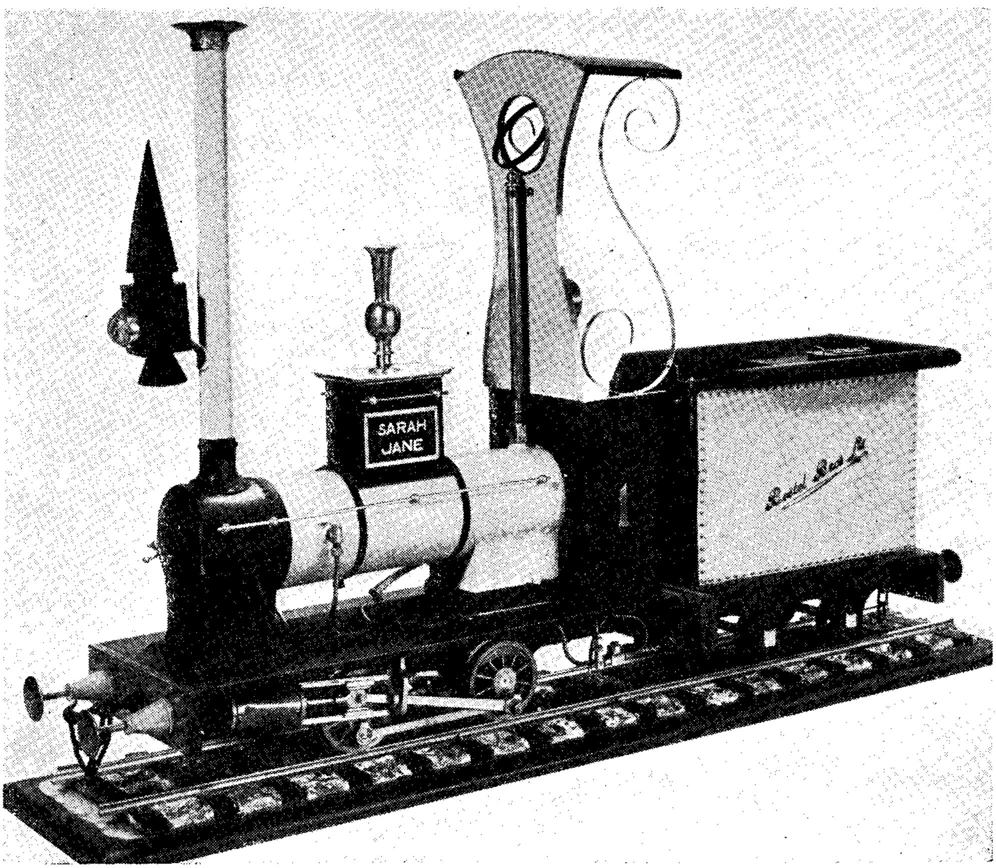
My oddment box yielded a short length of ⅝-in. round rod which exactly fitted the holes in the axleboxes. One end of this was turned down to something below ½ in. (I never bothered to measure it—did I hear an awful groan from the " precision dept." ?) so that it would go in the chuck on my pillar drill. At ½ in. from the bigger



Axlebox for plain bearings

end, I drilled a cross-hole ¼ in. diameter ; and in the end itself, drilled a 7/32-in. hole, tapped it ¼ in. × 26 and fitted a set-screw. A piece of ¼-in. round silver-steel was faced off both ends to a shade over ⅞ in. in length, and half the diameter ground away for about $\frac{3}{16}$ in. at each end, on opposite sides. The ends were backed off, the cutter hardened and tempered to dark yellow, and a final touch on a fine-grit grinding wheel, made the cutting edges mighty keen, as well as bringing them to size. The cutter was then pushed through the cross-hole in the holder, and carefully set central, the set-screw being well tightened up.

When drilling my axleboxes, I drilled an odd block of metal with a similar-sized hole ; and this was put in the machine-vice on my drill table, and the cutter tried on it, recessing to a depth of ⅛ in. only, and using a slow speed, about 150 r.p.m. On trying one of the ball-bearings in the recess, the latter proved a shade large, so a weeny bit was ground off the end of the cutter, and a further ⅛ in. recessed in the trial piece. The ball-bearing just pushed into this nicely ; so I went ahead and recessed all the boxes right away to the full depth of $\frac{7}{16}$ in., with the net result that all the twelve bearings—two to each box—fitted O.K. I regulated the depth of each recess, by aid of the graduated scale on the quill of the drilling machine ; but if your machine hasn't a scale, or if you do the job in the lathe, recess



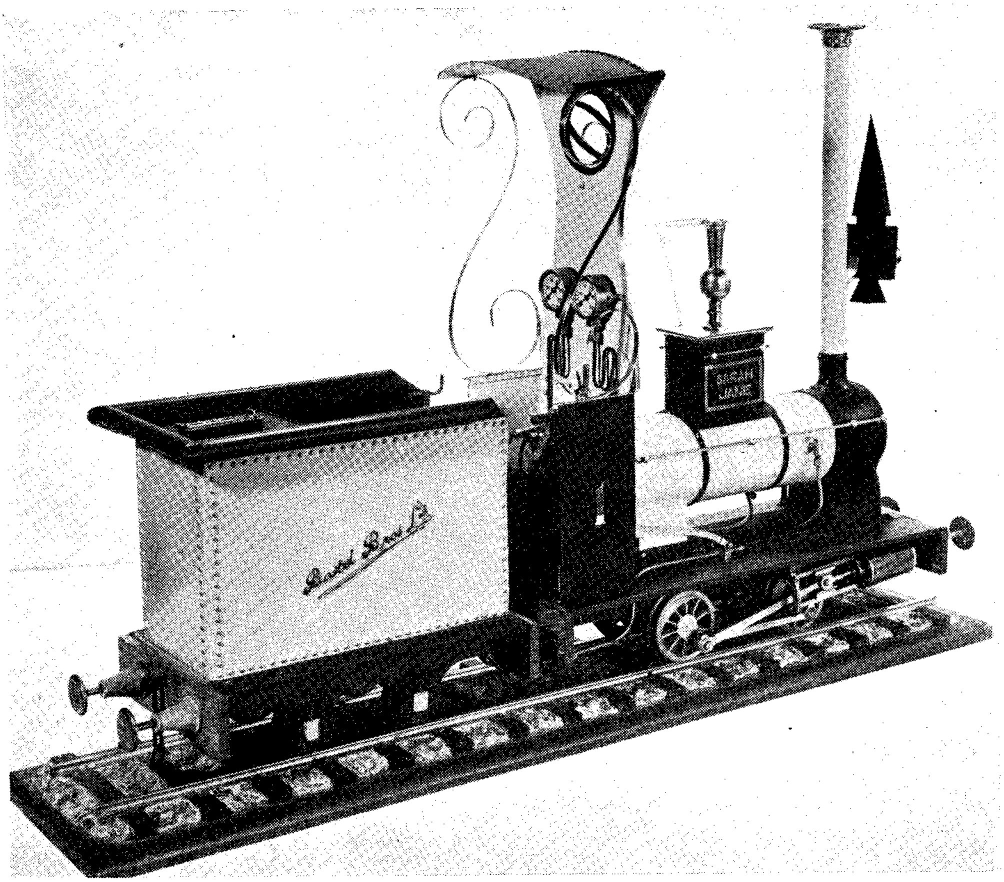
An "Emett" job by Mr. S. R. Bostel

one to the required depth by rule measurement, then make a scratch on the cutter-holder, level with the surface of the axlebox, and recess all the others until the scratch again comes level with the axlebox.

Spring-pins and Plates

The rest of the job is a "piece of cake." I've already explained in the *Tich* notes, how to locate holes for spring-pins, by putting each axlebox in place, putting on the hornstay, jamming the box up against it, and running the No. 30 drill through the holes in the hornstay, making countersinks on the underside of the axlebox. Drill No. 40, tap $\frac{1}{8}$ in. or 5 B.A. and fit spring-pins made from $1\frac{9}{16}$ in. lengths of $\frac{1}{8}$-in. round silver-steel. These are screwed $\frac{3}{16}$ in. at one end, and about $\frac{3}{8}$ in. at the other end, the shorter ends being screwed tightly into the axleboxes.

The spring retaining plates are merely $\frac{13}{16}$ in. lengths of $\frac{5}{16}$ in. $\times$ 3/32 in. flat steel strip. Round the corners off slightly, drill two No. 30 holes in one, at $\frac{1}{2}$ in. centres, and use it as a jig to drill the others. The springs are wound up from 19-gauge tinned steel wire, around a $\frac{1}{8}$-in. mandrel, and ordinary commercial steel nuts are used. The drawing of the assembly is self-explanatory, and needs no elaboration. To keep the axleboxes in running position whilst erecting the "works," put a piece of $\frac{3}{16}$ in. square rod between each axlebox and hornstay, and tighten the nuts on the spring-pins sufficiently to keep it in place. Next stage, coupled wheels and axles.



"*Juliemett*" *from the six-foot side. (Who will build a "Heath Robinson" to keep her company?)*

"Juliemett"

I've been expecting to see something like this happening, for quite a long time now; so when the originals of the reproduced photos arrived, I wasn't in the least surprised! Short four-wheeled locomotives with small driving wheels, such as *Juliet* and *Tich*, can easily be dolled up into looking like one of those comical caricatures of locomotives drawn by friend Emett, the well-known cartoonist. A Brighton reader, Mr. S. R. Bostel, has made a nobby job of his version, as you can see. The chassis, "works," and

boiler are as described for *Juliet*, the wheels being turned as small a diameter as the castings would allow; and the boiler has been raised in accordance with the standard type of Emett boiler, which shows plenty of daylight underneath. Boiler mountings, cab, tender, buffers and couplings, etc. are all made in accordance with the ideas expressed in the cartoons; and to prevent the cab side of the weatherboard looking like Mother Hubbard's cupboard, Mr. Bostel mounted the boiler steam gauge on it, and added a second gauge connected to the steam-chests, so that variations between boiler and steamchest pressures can be seen at a glance, when the engine is running.

All the usual accessories are fitted, including an injector, which can be seen in one of the pictures. Owing to the length of the chimney, no liner was fitted at the lower end, but the blastpipe was raised to the correct distance below the opening. Our friend says that the exhaust comes out with a lovely "fluey" noise, and is so vigorous that when the engine is working hard, the chimney emulates a peashooter, sending red-hot "peas" 15 ft. up into the air. She can "do her stuff," at that; at last year's exhibition of the Brighton and Hove S.M.E., she took six-passenger loads up and down the track, the average weight of a load being around 70 stone. The whistle was made from part of the barrel of an old cycle pump, and is in the correct position on top of the boiler, in front of the cab. Mr. Bostel says this is the only engine he knows of, in 3½-in. gauge, which has the whistle in the correct position. He also wishes to acknowledge the kind help of friends in building the engine, especially the Hughes brothers of Byfleet, and Bill Warnett of Wivelsfield Green. Ere these notes are in print, I hope to have seen the "living cartoon" perform on my own road; I'm wondering what the old Coulsdon signal will think of her!

The Drummond Central Leadscrew

As I had one of the first 3½-in. Drummond lathes, with single slide-rest and central lead-screw, that was turned out from the Ryde's Hill shop—it cost £13 10s. on the "never-never"; £1 down and 10s. per month!—I was naturally interested in the recent correspondence about these fine old machines; and I'll go so far as to say that nothing on the market today, could approach them for sheer value. The only objection I had, was that the leadscrew in the centre of the bed, rapidly became choked with turnings and chips; and on my own machine, I rigged up a sliding tin shield that minimised the trouble. I remember that in this journal, there appeared several letters from users of these lathes, describing how they overcame the difficulty with devices like a canvas strip operating like a spring-roller blind, or folding up like a Jacob's ladder, and so on. However, if Arthur Drummond had fitted the arrangement applied to the top-slide screw of my Boley lathe, he need not have shifted the screw outside the bed.

The Boley top-slide has a central screw, but it is entirely covered by a flexible steel strip; and how the nut contacts the screw through this strip, has puzzled everybody who has seen the machine. The explanation is ridiculously simple. The nut is not screwed into the bottom of the sliding tool-holder, but is made in the form of a bridge, which straddles the strip, the latter passing through a slot formed in the bridge to accommodate it. The idea could easily be applied to any of the old Drummond lathes still in existence, and affords complete protection to the central leadscrew.

Double *v.* Single Chimneys

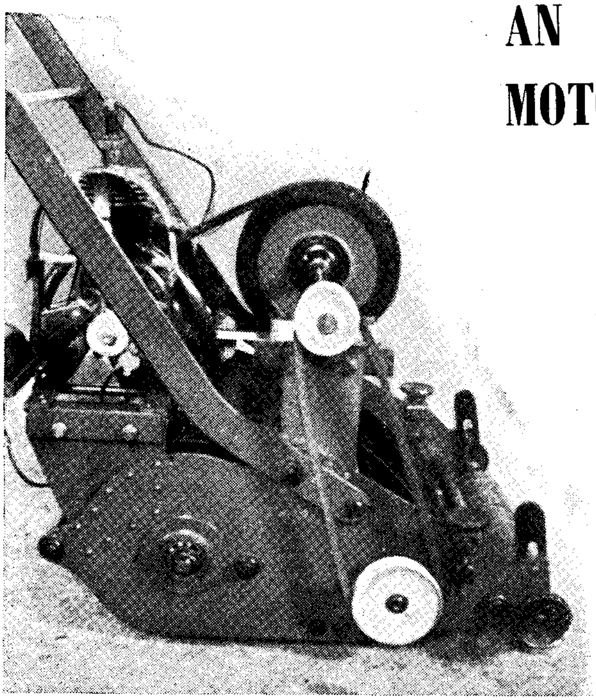
A number of enquiries have been sent in by readers asking if we can explain why, after all the claims made for multi-jet blast-pipes in locomotives, the new British Railways' standard 4-6-2 engine has only a single blast-pipe and chimney.

In his recent paper read to the Institution of Locomotive Engineers, and describing the locomotive designs that have been adopted for future production, Mr. E. S. Cox, M.I.Mech.E., Executive Officer (Design), Railway Executive, referred to the drafting arrangements which, he said, have been based on a long series of tests at both Rugby and Swindon. These have shown that double and other special blast-pipe arrangements proportioned to produce higher vacuum for a given back pressure at maximum output, give inferior performance at low outputs, and are not so versatile throughout the whole range as is the normal single blast-pipe. The majority of locomotive work in Britain is undertaken at moderate output; therefore, the single chimney and plain blast-pipe have been retained, and have been proved to be capable of giving excellent results if correctly proportioned.

We recall G. J. Churchward's experiments made with the object of discovering the best proportions of smokebox arrangements and details for G.W.R. locomotives, now more than 40 years ago. Eventually, he adopted certain standards covering all types of engines according to the general kind of work which each type of engine was designed to do. We believe that Swindon made no alteration to the Churchward standards until 1945, when F. W. Hawksworth tried a dual blast-pipe and double chimney on engine No. 1000, *County of Middlesex*. This engine is still so fitted, but shows little difference from her 29 single-fitted sisters in performance.

AN "ATOM V" 30 c.c. MOTOR LAWNMOWER

by DUNCAN GEEKIE



View showing drives to countershaft and cutting cylinder

MANY readers will perhaps consider that this is not strictly model engineering; nevertheless, it demonstrates one of the many utilitarian roles that the miniature petrol engine can be called upon to perform. While I am a keen model engineer, I am afraid I am not a very enthusiastic gardener and I always regard the task of cutting the grass with the normal hand-propelled lawnmower as a necessary evil involving much hard labour and a waste of my precious leisure time. This was undoubtedly the hard way. It was with these thoughts in mind that I was led to consider the possibility of motorising the lawnmower, and it is hoped that the following account of my subsequent experiences will be of some interest to anyone considering a similar conversion.

The machine is a 12-in. Webb "Witch" which had a chain drive from the roller to the cutting cylinder, and as the side plates are of $\frac{1}{4}$-in. mild-steel, this greatly simplified the marking-out and riveting required for the addition of vertical plates to carry the engine unit and countershaft. It should be remembered that the job was in the nature of an experiment, and it was, therefore, done during the winter when the lawnmower was not in use. The adaptation was so designed that the machine could have been restored to its original form if it had proved unsuccessful, or in case any mechanical breakdown occurred involving lengthy machining operations. The roller type of machine would appear to be the most suitable for conversion, but as manufacturers have different forms of construction, the method of adaptation may require some variation to suit individual requirements.

At this stage I should make it clear that the engine operates the cutting cylinder only and does not, therefore, supply any motive power to the lawnmower itself. This, however, has certain advantages, one of them being that a clutch is not necessary, and as rubber "V" belts are used, adjustment can be made so that slip will not occur should a stone or other hard object jamb in the cutting cylinder. The number of cuts per yard can be varied by operation of the throttle and the grass can be cut at any convenient walking speed.

The engine, magneto, cooling fan and petrol tank are mounted on an angle-iron chassis and form a complete unit which can easily be removed from the lawnmower if necessary. The engine is the "Atom 30 c.c." as designed by Mr. Westbury, and described in this journal a few years ago. It was built according to the drawings, except that an additional $\frac{1}{2}$-in. bore ball-race was inserted at the fly-wheel end of the crankcase to take the side thrust of the V-belt. In addition, the compression ratio was reduced by machining the cylinder casting $\frac{1}{16}$ in. longer than specified and the internal capacity of the cylinder-head was also slightly increased. When the engine was completed, however, it was found that the idling speed was still too high. After experimenting, a distance-piece of duralumin was inserted between the cylinder and the cylinder-head, and as this was about $\frac{5}{16}$ in. thick it was possible to make it in the form of an additional cooling fin. The bore of the choke tube of the "Atom R" carburettor was too large for the comparatively low speeds required, and a barrel throttle-type carburettor with a $\frac{5}{16}$-in. bore as fitted to the "Jenson 10 c.c. C.I. Special" was tried and this gave the necessary flexibility of control. The throttle control is taken up to the handles of the lawnmower by bowden cable.

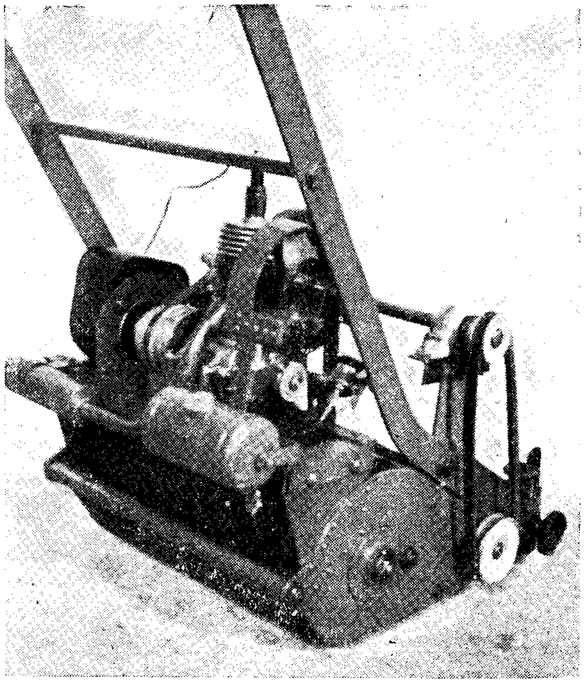
A normal 14 mm. plug is used. This is because a few were on hand at the time and the threads were modified to enable the plug hole

in the cylinder-head to be screw-cut in the lathe with the standard set of change wheels. This size of plug tends to remain too cool and becomes dirty after a few hours, and probably a ⅜-in. plug would have been more satisfactory, as the engine is lubricated by the petroil system. It was considered that the oil pump specified for the engine was unnecessary for the purpose for which the engine was required.

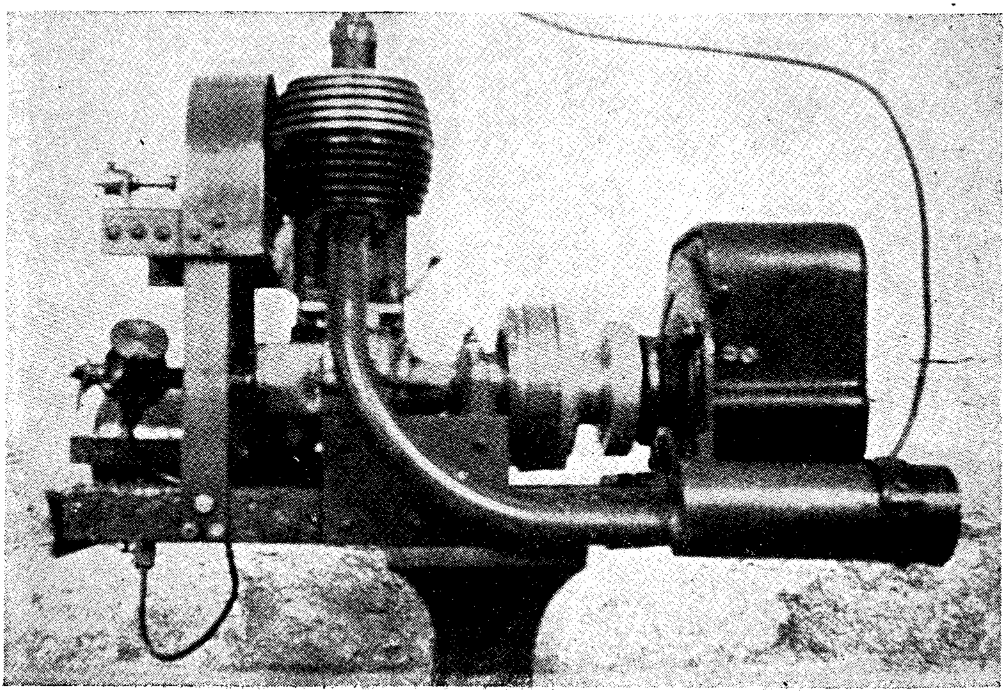
A small magneto (*ex*-services) of the rotary magnet type was obtained from an advertiser in THE MODEL ENGINEER. As it had a driving flange for taking a driving pin, this convenient method of driving was adopted; it had, however, no provision for advancing or retarding the spark and the original fixing had been located by a spigot. The magneto was mounted on a vertical steel plate which had a circular hole to take the spigot and is secured by screws through slots in the plate, thus enabling the magneto to be partially rotated. When the position which gave the correct advancement was found, the screws were tightened and the magneto has been left in that position.

As the flywheel is grooved for a starting cord, a centrifugal type of fan could not easily be fitted at that end of the engine. A two-bladed

(*Continued on page* 535)



View showing method of mounting magnets; cooling fan and guard; petrol tank and rear exhaust



The engine unit

An Inspection Lamp

by S. F. Weston

IN engineering practice, it frequently happens that it is necessary to examine a hidden surface or portions of a machine by means of reflection in a small mirror. There exists the difficulty of properly illuminating the part in question, as whilst it may be possible to insert a small mirror into position, it is not always so easy to introduce a lamp to give effective lighting of the surface to be examined.

To meet this difficulty, the inspection lamp illustrated herewith was designed and found to be satisfactory.

An ordinary electric hand torch is used, the bulb of which is removed from the reflector and arranged at the end of a tube extension to which is also attached a small mirror. The latter is placed at an angle of about 150 deg. with the vertical axis of the torch and quite near the bulb.

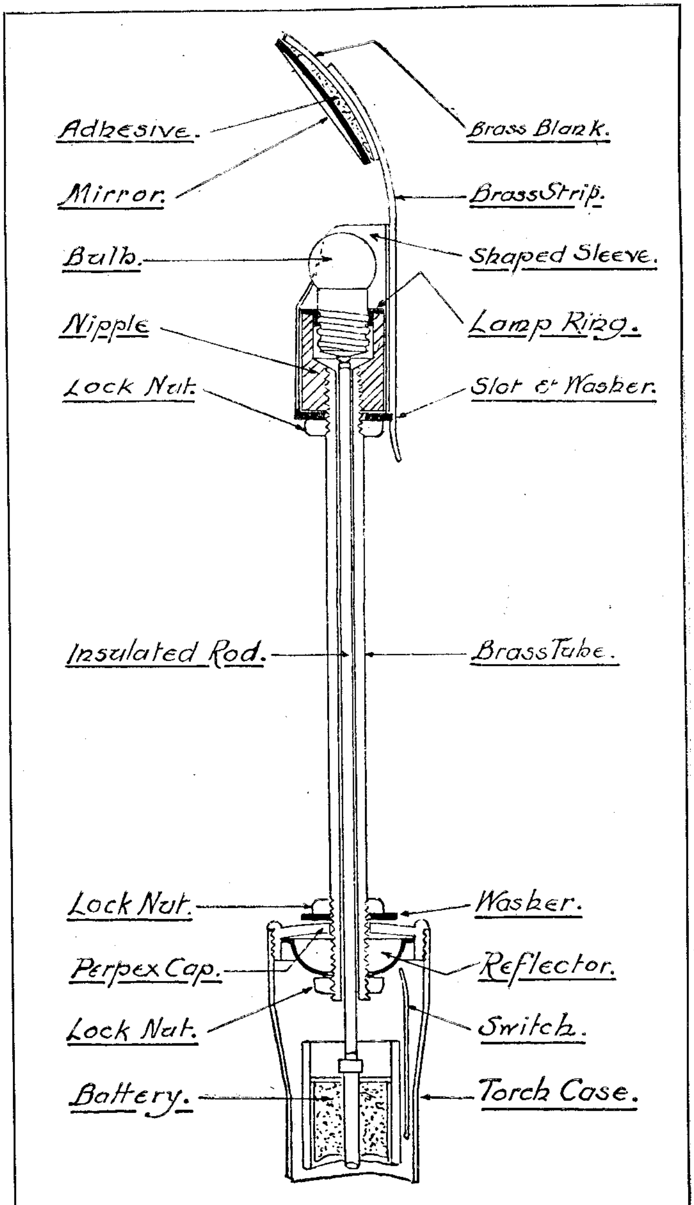
The result of this arrangement is that the light emitted by the bulb is reflected back at an angle from the mirror, and thus shines on the surface or part under examination.

It should here be noted that the dimensions given were to suit the work in question, but can be varied, of course, either way to suit other work.

A length of brass tube, $\frac{3}{16}$ in. i.d. by $\frac{5}{16}$ in. o.d., was screwed at either end. At the lamp end, a brass nipple $\frac{5}{8}$ in. o.d., was screwed on and held fast by a thin lock-nut. The bore of this nipple was enlarged at one end to neatly fit the lamp carrier ring from the torch, which ring, after tinning, was securely soldered to the nipple. A neat-fitting $\frac{5}{16}$-in. washer was inserted between the nipple and the lock-nut.

The other end of the 5-in. length of tube was simply fitted with lock-nuts and washers.

The mirror, $1\frac{1}{4}$ in. diameter, was of the magnifying type, and, therefore, slightly concave. To accommodate this, a brass blank, $1\frac{1}{4}$ in. in diameter by $\frac{1}{16}$ in. thick, was dished to suit



VERTICAL SECTION.

and the mirror attached by adhesive, after the disc was mounted on its carrying sleeve.

The carrying sleeve for the mirror was made from a short length of 5/8 in. bore telescope tube and the blank attached to same by means of a brass strip 1/16 in. thick by 3/16 in. wide. At one end this strip was riveted to the dished blank by one 1/16 in. copper rivet and then soldered, the other end was riveted by two similar rivets to the sleeve, the end projecting beyond the bottom of the sleeve by 3/8 in. The sleeve was split longitudinally opposite to the brass strip for its entire length, by means of a metal-piercing saw. The strip was slotted just under the sleeve, the slot being of sufficient width to embrace the washer. It was found that the slot in the sleeve just gave the right amount of spring to allow the engagement of the strip with the washer, and thus prevent the detachment of the sleeve and mirror when in use. This could, however, be instantly detached by utilising the short projecting end as a lever when pressing with the thumb.

The tube forms the electrical contact to the screwed cap of the lamp down to the reflector, which remains in its original position in the torch. The central contact is made by a 1/8 in. diameter brass rod insulated from the brass tube by being covered for almost its whole length by a layer of surgeon's adhesive tape. The rod, when covered, must slide quite easily up and down the bore of the tube.

The torch used was fitted with a Perpex lens and cap in one piece; this was simply drilled with a 5/16 in. clearing drill in the centre of the lens and the rod passed through and locked above the lens and below the reflector with washers and lock-nuts. The position of the reflector must not be altered, as the switch of the torch makes contact with same when in operation.

It will be noted, that any part of the lamp is readily accessible, the electric connections robust and entirely free from wires and terminals.

If a plain mirror is used instead of a magnifying mirror, there is, of course, no need to dish the blank—this simplifies the construction.

If a magnifying mirror is used, it should not give greater magnification than 1.5 diameters, otherwise there is a danger of distortion.

The sleeve carrying the mirror is shaped away, as shown, at the slot side to give additional direct lighting to the surface being examined.

An "Atom V" 30 c.c. Motor Lawnmower

(*Continued from page* 533)

fan was, therefore, mounted on a metal platform at the other end. This fan is driven at about 2¼ times engine speed by a small belt from a pulley fitted to the end of the rotary-valve spindle, and belt tension is controlled by a small adjustable jockey pulley. Various forms of belts were tried, but one made from a leather boot lace has given complete satisfaction.

Neighbourly consideration made the fitting of silencers necessary; they are reasonably effective and the resultant noise is much less than that of the normal motor mower. The petrol tank is so positioned that when full the level of the petrol is slightly below the jet of the carburettor. It has not been found necessary to use a float chamber, as the difference between the level of the petrol when the tank is full and when it is empty is only about 2 in.

The engine chassis is mounted on two vertical steel plates riveted to the sides of the mower and the countershaft is mounted in a similar manner. In both cases the bolt holes in the uprights are slotted to provide adjustment for belt tension. The diecast pulleys and plumber blocks are of standard type, but the large countershaft pulley was turned from 1-in. beech and is secured to the shaft with a flanged brass boss. The rubber belts are standard ½ in. "A" section and the total reduction from engine to cutting cylinder is 5-1.

In operation, the motor lawnmower is quite easy to push, as the large rollers have ball-bearings and there is little resistance to overcome.

Last season the grass, which is of the short fine variety, was cut about once a week from the end of March until October. The longest continuous cutting time was 50 min. and during this time there was no sign of overheating, which indicated that the cooling system is effective. On test, the engine speed was 1,728 revs. per min., and as the cutting cylinder has eight blades, this represents 2,765 cuts per minute.

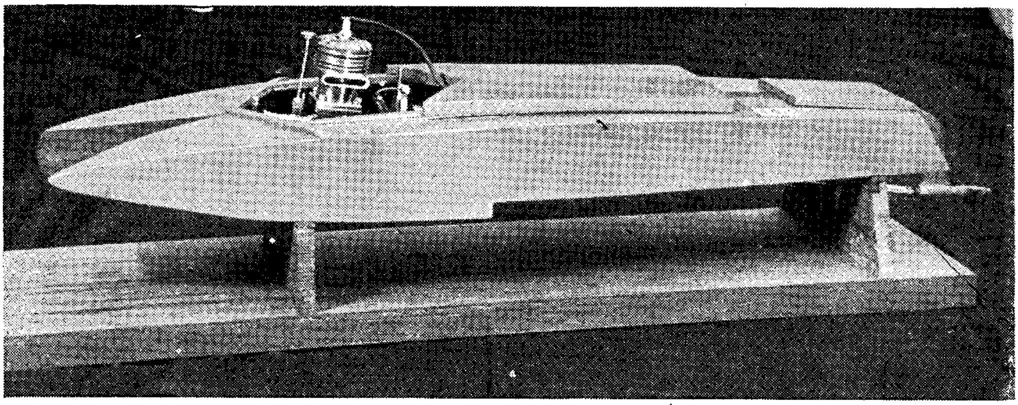
The converted mower is quite suitable for the average sized garden lawn, but where the grass is of a coarse variety it might be advisable to use a slightly larger engine.

While the time spent was amply rewarded by the pleasure given by the actual construction, still more satisfaction has been obtained in its subsequent operation, as it is possible, with the power available, to set the striking plate of the mower very low and thus in effect the lawn can be given a very close shave.

Petrol rationing was in force when I was ready to start cutting the grass. My application for two gallons of petrol, which I thought was ample to see me through the summer, was returned to me by the Petroleum Officer with a note to the effect that the grass cutting season did not commence until April, and that I should apply later stating the acreage of grass to be cut and to give an estimate of the number of gallons of petrol consumed per hour!

The Third

Northern Models Exhibition

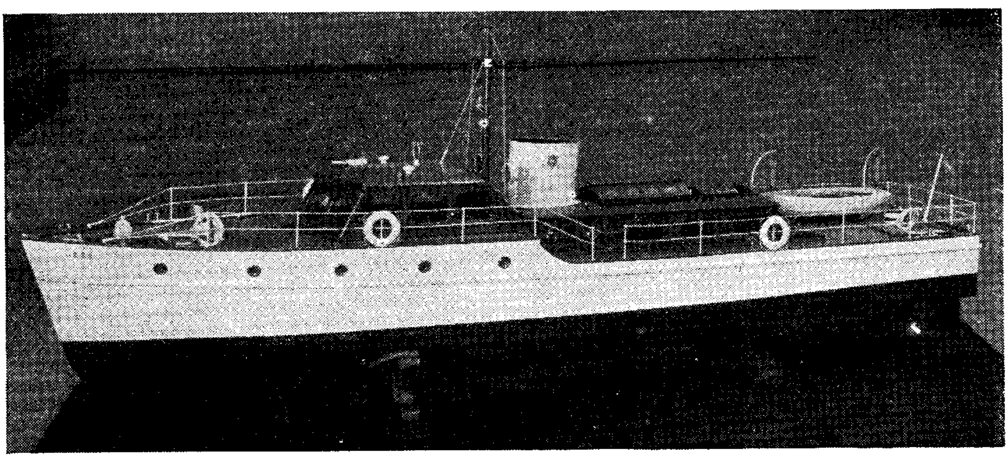


A "first" is seen here. It is a 5-c.c. hydroplane made by Mr. H. Halsall, of Southport, and showed good, clean work throughout

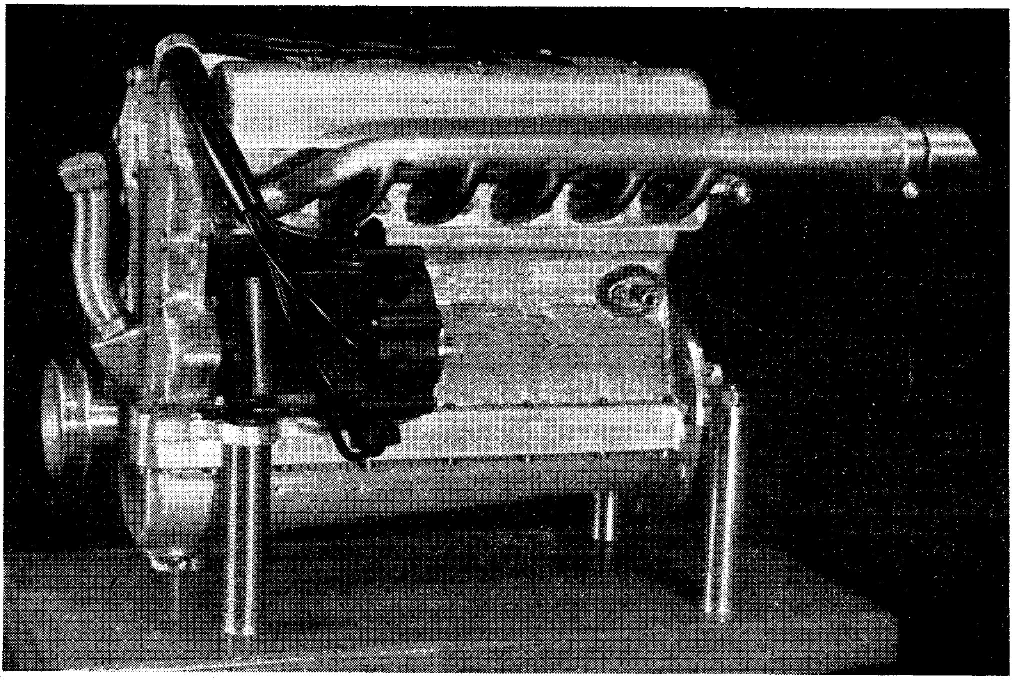
THE photographs reproduced on these pages and on our cover depict a few of the exhibits which were to be seen at the third exhibition organised by the Northern Association of Model Engineers. The cover picture shows the three principal prize-winners in the general engineering section. First, the engine in the foreground is a free-lance two-cylinder compound marine engine by Mr. E. B. Wilcox, of the S.M.E.E. ; it is mounted on a circular stand incorporating gearing which can be operated by a handle for the purpose of rotating the crankshaft of the engine. The workmanship is most excellent in every detail.

Second, there is the beautiful little triple-expansion marine engine made by Mr R. Jacques, of Boston ; the general proportions and workmanship are excellent and, in fact, only just escaped a " tie " with Mr. Wilcox.

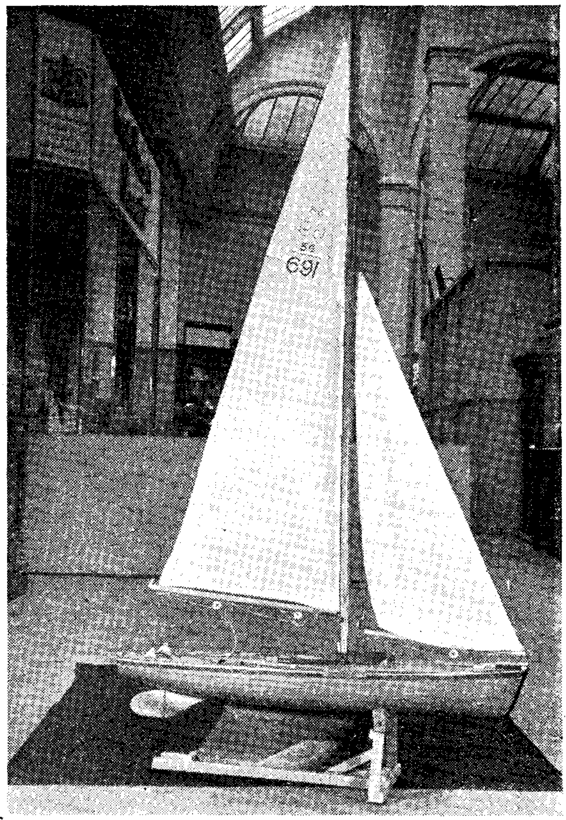
Third, in the right background is a vertical steam engine by Mr. F. Knowles, of Burton-on-Trent. While this lacked the delicacy of the two other engines, it was very nicely finished to a degree which is not very often seen in an engine of this type.



A 4-ft. steam-driven cabin cruiser built by Mr. J. W. Greenhalgh, of Withington, winner of the first prize in the Working Steam and Power Boats class. Its simplicity combined with very good workmanship were its principal features



Among the internal-combustion engines, this unusual six-cylinder petrol engine by Mr. F. W. Waterton, of Manchester, won the premier award. Again, good workmanship characterised its construction



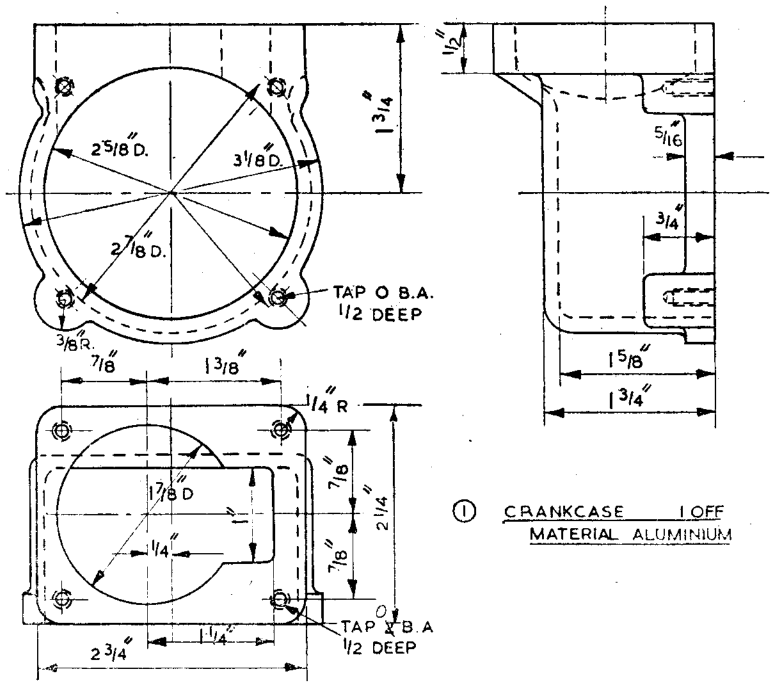
Mr. C. R. Lunn, of Oldham, was awarded second prize in the class for Working Model Yachts. His 36-in. "restricted" yacht seen here was a nice piece of work with its planked hull, well-made mast and neat fittings

PETROL ENGINE TOPICS

*A 50 c.c. Auxiliary Engine

by Edgar T. Westbury

UNLIKE the majority of engines, the crankcase of this one contains no bearing housings, and is relatively simple to machine and fit, but care is necessary to obtain accurate register against the face of the main housing, and also to ensure squareness of the cylinder seating. It is not easy to hold this casting in the chuck, and the two main machining operations are best carried out by clamping it to an angle-plate. Marking out is desirable, to ascertain the amount of material which must be removed from the faces, and ensure that the cylinder seating centre is properly located. For this purpose, the cored hole should be plugged with hardwood or soft metal, and the centre-line marked-out with reference to the centre of the crankcase barrel.

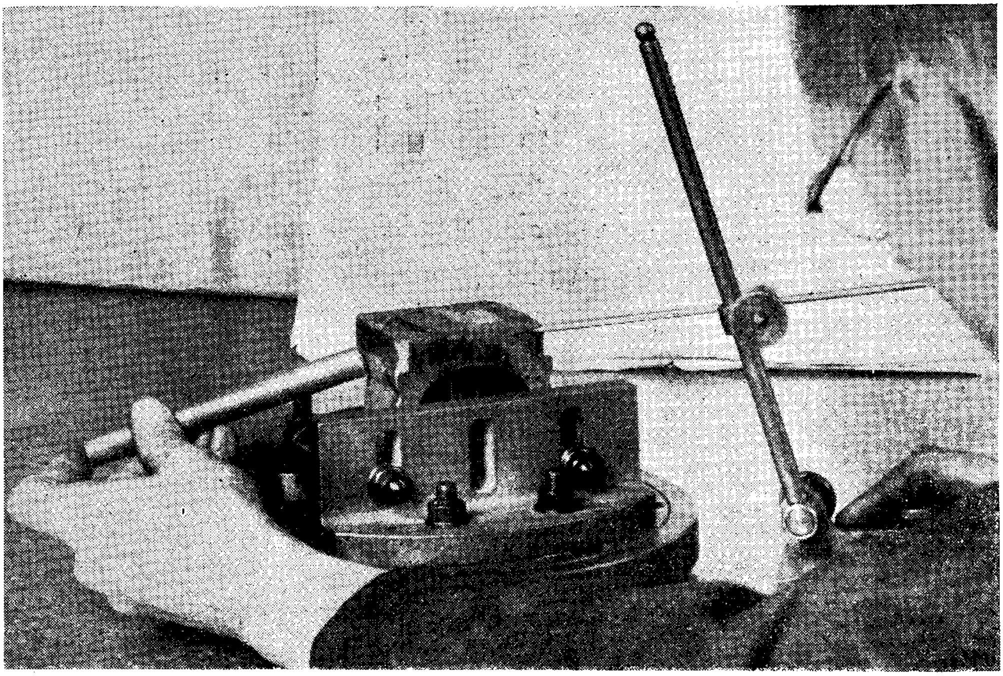


① CRANKCASE 1 OFF
MATERIAL ALUMINIUM

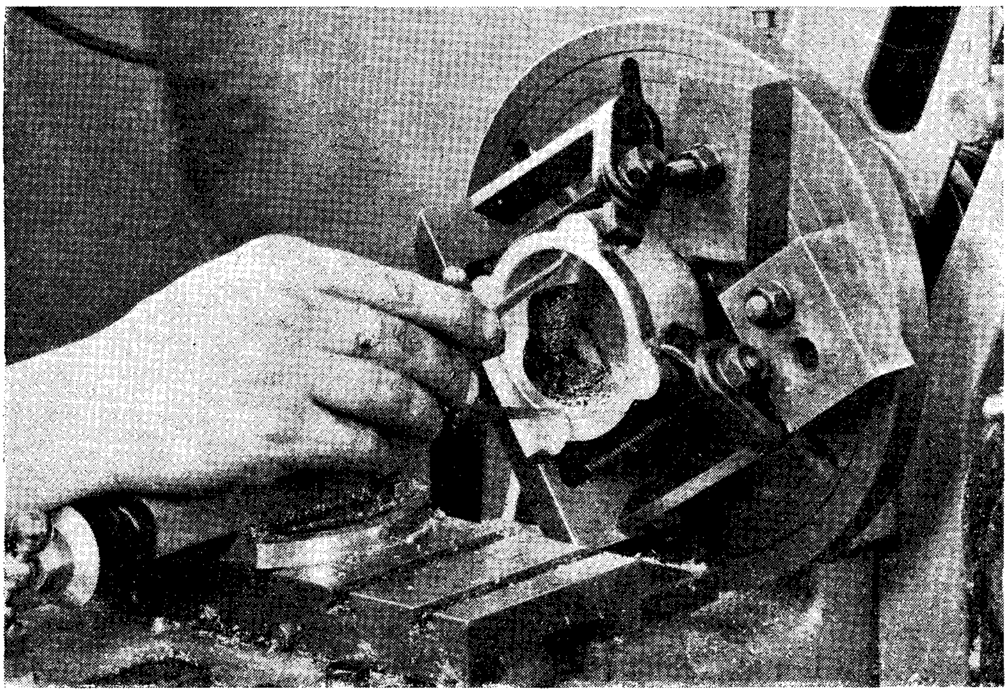
It will be noted that the cylinder centre is offset, or *desaxé*, to the extent of ¼ in. to the shaft axis, a feature which I have employed with advantage in several of my engines. It reduces the angularity of the connecting-rod on the power stroke, thereby easing side thrust on the piston, so that the life of the engine is increased and it tends to pull more smoothly, especially under conditions of heavy load at slow speed. Incidental advantages are that port timing can be slightly improved, and the opening period of exhaust and transfer ports increased, without making them excessively deep so as to reduce the effective power stroke of the piston.

The casting is first set up by bolting the main face to an angle plate, which in turn is mounted on the faceplate. In the preliminary setting, and squaring up of the cylinder seating, it is a great advantage to lay the faceplate in a horizontal plane ; this enables the various bolts and clamps to be manipulated more easily, and if the faceplate is laid on a surface plate or other true surface, a scribing block may be used to check up squareness. The photograph shows how this operation is carried out ; it will be seen that the scriber is used to check the previously marked line which shows the position of the finished surface, and with the clamping bolts only partially tightened, the casting may be adjusted by gentle tapping on

* *Continued from page* 474, "*M.E.*," *April* 12, 1951.



Setting up the crankcase for machining the top surface

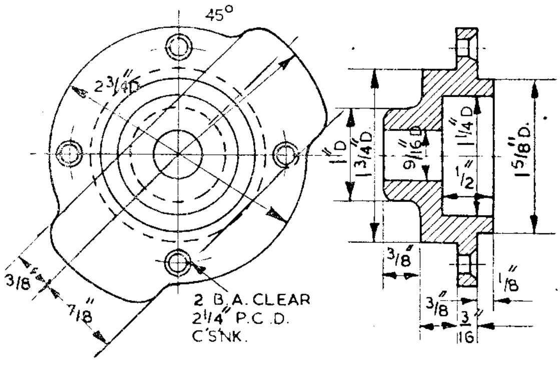


Crankcase mounted on faceplate for facing and boring the barrel to fit spigot of main housing

one side of the other. It may be remarked that the dodge of using a piece of metal rod for this purpose is often preferred by experienced hands as being more sensitive than using a hammer or mallet. The bolts clamping the casting are then fully tightened.

When the faceplate is attached to the lathe mandrel, the entire assembly of casting, clamps and angle-plate is shifted to centre the cylinder seating, working to the marked centre on the plug or bridge-piece, which is afterwards removed for boring out the cylinder register. It is, of course, necessary to balance the offset weight of the angle-plate by bolting pieces of metal to the faceplate on the opposite side.

Having machined the cylinder seating, the casting is now mounted by the face surface on the angle-plate for the second operation. Here it may be appropriate to check up on the squareness of the angle-plate itself, as it is most important to ensure that the two faces of the crankcase are



(3) MAGNETO MOUNTING FLANGE 1 OFF
MATERIAL ALUMINIUM

exactly at right-angles when finished. A sheet of thin paper may be interposed between the cylinder seating surface and the angle-plate to avoid bruising the former and, incidentally, improve the grip.

The crankcase is now faced and bored to fit the spigot of the main housing; a really snug push fit is very desirable—to say the least—as slackness at this point would mean that all the working stress would have to be taken by the four crankcase studs. Unless one has an accurate reference gauge available to set the calipers to exact size, they should be set slightly undersize and the spigot fitted by "cut-and-try" methods. The common error of spoiling the job by going just a little too deep on the final cut may be avoided by offering up the spigot each time after entering the tool not more than $\frac{1}{16}$ in. into the bore; and slackness will then only be at the mouth of the hole and will not have serious results.

In both the faces of the crankcase, tapped holes have to be drilled for studs, and these are most easily located from the mating parts, namely the main housing and cylinder base respectively.

It may be remarked here that a few minor alterations have been made in dimensions and other details since the first engine was built; these do not in any way affect the general design or methods of machining, but have been found desirable as a result of experience. For example, the size of the studs which secure the main structural components has been increased, because while the original ones were strong enough for their primary purpose, they were liable to become worn or strained after the engine had been dismantled and reassembled a few times in the course of experiments.

The threads specified for most of the studs, nuts and screws are to B.A. standards, which are fairly readily available, and most model engineers own or have access to the taps and dies. If, however, other standard threads of comparable sizes are preferred, or more conveniently obtained, they can be used. Whitworth pitch threads are very suitable for screwing into aluminium, though rather on the coarse side for nuts on bolts or studs, where B.S.F. threads are better, as they provide greater core strength, and are less liable to shake loose.

Magneto Mounting Flange

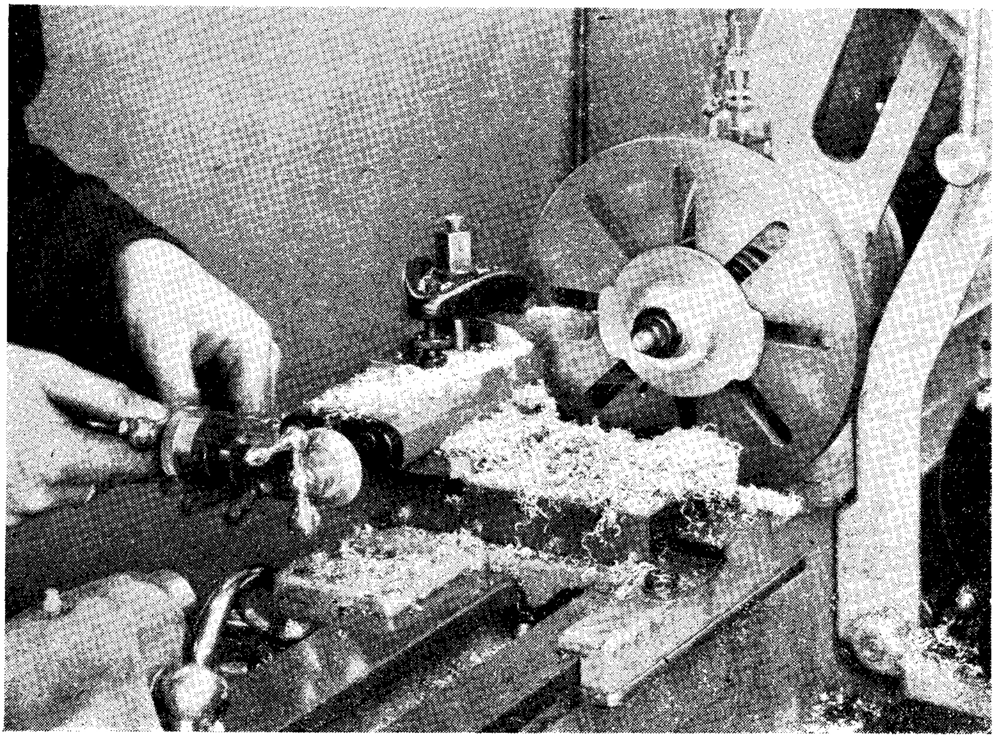
This incorporates the housing for the outer main ball-race, and is therefore an essential item, irrespective of whether a magneto is fitted or not. The shape and dimensions are based on the assumption that a Wico-Pacy "Bantamag" is to be fitted, but if another type is used, it will only affect the shape and size of the outer flange, and the spigot or other form of register provided to keep the magneto backplate in concentric alignment with the bearing.

In the machining of this item, it will usually be found convenient to chuck it first by the inner boss, and carry out the entire machining of the ball-race housing, facing of front edge and outer flange, and turning the spigot to fit the recess in the magneto backplate. If the latter is not available at the time this casting is machined, the spigot may temporarily be left oversize, to be fitted at a later stage; but the advantage of carrying out all work on this side of the casting at one initial setting, if possible, will be obvious.

The $\frac{9}{16}$ in. hole which passes right through the casting forms a clearance for the shaft, and neither its exact size nor finish is of great importance, but it should at least be bored concentrically. In boring the recess for the ball-race, however, great care should be taken to ensure a good fit, and as in the case of the inner ball-race, a light press fit is recommended. It will be noted that the inner face of this recess is not relieved in the centre, as in this case the race is not pressed right home, but has a grease-impregnated felt washer behind it; the purpose of the latter being to ensure that the race is kept lubricated, and also to act as a gland to prevent ingress of dirt or water.

After all operations at this setting are completed, the casting is reversed for machining the inner side. It is necessary to ensure that the inner spigot is exactly concentric with the ball-

race housing, and here again, several different methods of mounting the casting are possible. One of the simplest ways is to use a spigot mandrel held in the chuck, and this may with advantage incorporate both a large diameter register to fit the ball-race recess, and a small pilot extension to fit the clearance hole, thereby providing better security of mounting, and positive insurance against any risk of tilting. Alternatively, a should be machined true at the same setting. Any errors in either respect would entirely defeat the object of providing means of locating the work accurately from the previously machined surfaces. The smaller boss on the inside of this casting is, however, relatively unimportant, and hardly needs to be machined at all, though it is worth while to clean it up, and will take only a few minutes to do so while the work



Second operation on magneto mounting flange, located by spigot in ball-race recess (machined at previous setting) and held against faceplate by means of a drawbolt

mandrel running between centres and provided with similar two-diameter registers, may be used.

The method illustrated in the photograph, however, differs from both of these, though the principle of locating from the bore is the same. It entails the use of a plug or "bung," accurately machined *in situ* to fit the ball-race recess, similar to that employed in the case of the main housing; but in this case it is not practicable to use clamps to hold the work back against the faceplate, as the only surface to which they could be applied has to be machined. Instead, a long bolt is used, which passes right through the hollow mandrel, and enables the work to be drawn firmly up to the faceplate, while being held in true concentric location by the bung.

It is, of course, essential that the inner spigot should be a neat fit in the bore at the outer end of the main housing, and that the flange face

is set up for the more important operations.

The four holes for the screws which secure this part should be marked out, preferably with the aid of an indexing device on the lathe headstock while the job is in the lathe. Although inaccuracy in locating these holes will not have any serious effects, if the tapping holes in the main housing are "spotted" off from them, it is worth while, in the interests of conscientious workmanship, to take pains to get things right. There is always the possibility that some day you may have to fit a new flange for some reason, and as it is not possible to "spot" the holes in the flange from those in the main housing, you will be very thankful you took these pains in the first place! Excuse me harping on this theme, but I am constantly encountering examples of slovenly work, the excuse for which is that "It can't affect the efficiency of the engine" or—even

(*Continued on page* 544)

An Electrical Test Instrument

by J. Stebbings

MUCH has been written in the past about various ways of making up one's own multi-range test meter from surplus equipment. Such methods, however, usually involve the use of an existing instrument for finding out the full scale deflection of a meter movement or for calibrating the meter in its final form. Now, good quality multi-range meters are by no means cheap and there must be many model engineers, like the author, who have neither the means to purchase one nor the necessary connections to procure one on loan. A rather unusual solution to this problem may, therefore, be of interest.

The author had accumulated over a period of time a number of single range surplus meters for a few shillings each. They were of various ranges for both a.c. and d.c., being bought as required for particular purposes. As the meters lying about loose were inconvenient for use and liable to become damaged, it was decided to mount them all in a single metal container with sockets for test leads.

An aerial coupling equipment "C" (for wireless set No. 11) was purchased for a few shillings. This consisted of a copper-plated steel-box with hinged lid and webbing handle containing various coils, and also a handsome plug-in 0 to 350 mA. thermocouple meter to add to the collection. Now, thermocouple meters are useful types, and although designed for measuring current at radio frequencies, they may be used on 50 cycle a.c. or on d.c. The writer had one other instrument of this type reading up to 3.5 A, a moving-iron voltmeter 0 to 15 V, a.c. or d.c. and a moving-coil meter scaled 0 to 10 and, happily, its full scale deflection of 0.5 mA marked on the dial.

It was decided to make the moving-coil meter into a d.c. voltmeter by the inclusion of 1 per cent. tolerance series resistances as follows :—

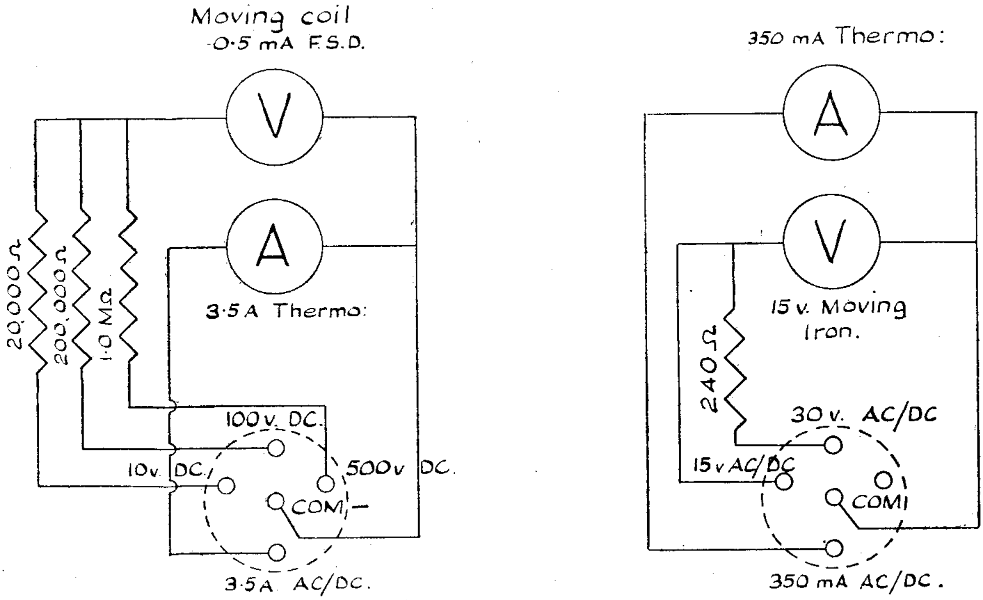


Fig. 1. Circuit diagram with socket connections

Resistance ± 1%	*Voltage Range* (*D.C.*)
20,000 ohms	0 to 10
200,000 ohms	0 to 100
1.0 megohm	0 to 500 (Scale reading divided by 2)

The moving-iron voltmeter had only two markings on its scale at 10 V and 15 V. This, no doubt, accounted for its cheapness. Additional markings at 1 V intervals were added by the following method. A transformer was available having an output slightly over 15 V on light load (16 V from accumulators would have done just as well). An old radio variable resistance of some 10 ohms was unwound, and all kinks removed from the wire, which was afterwards connected across the terminals *A* and *B* of the transformer, as shown in Fig. 2. One terminal of the voltmeter was connected to *A* and a flexible lead from the other was moved along the wire from *A* towards *B* until a meter reading of 15 V was obtained at a point *C* near to *B*. The lengths of wire *AC* and *BC* were carefully measured.

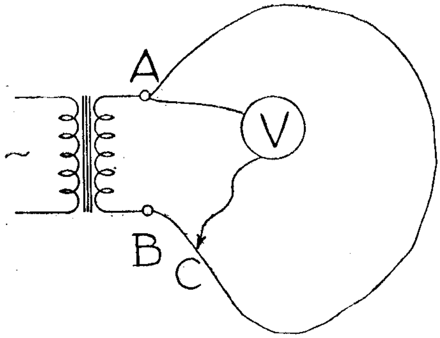


Fig. 2. Connections for finding length of potentiometer wire

The length of wire *AC* was then wound zig-zag fashion between pairs of pins driven into a board in two rows so that it was divided at the pins into 15 exactly equal parts, as shown in Fig. 3. The ends *A* and *B* were reconnected to the transformer as before. Clearly the voltage drop between each pair of pins was equal to 1.0 V. It was then a simple matter to connect the flexible lead from the voltmeter to each pin in turn, starting from *A* and engraving a division on the dial with a sharp scriber under the needle point at each stop. A check was available at 10 V already marked. Due to the pecularity of the moving-iron type of meter, the scale becomes cramped towards the zero, and in this case 4 V was the first division which could be engraved.

The moving-iron meter (0 to 15 V) was then connected across a.c. so as to read 15 V. It was found that by connecting a 240 ohm resistance in series with the voltmeter its reading was reduced to exactly half. So now two further ranges were available, namely :—

(*a*) 0 to 15 V, a.c. and d.c. and

(*b*) 0 to 30 V, a.c. and d.c. This range multiplying should not be carried a stage further,

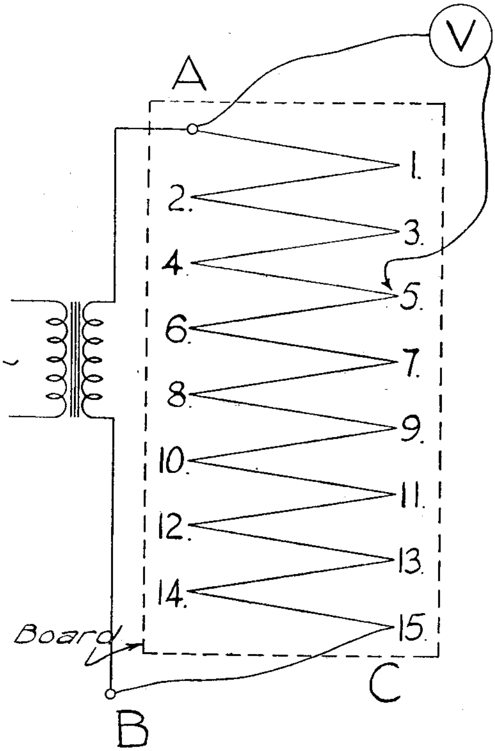


Fig. 3. Potentiometer for subdivision of voltmeter scale

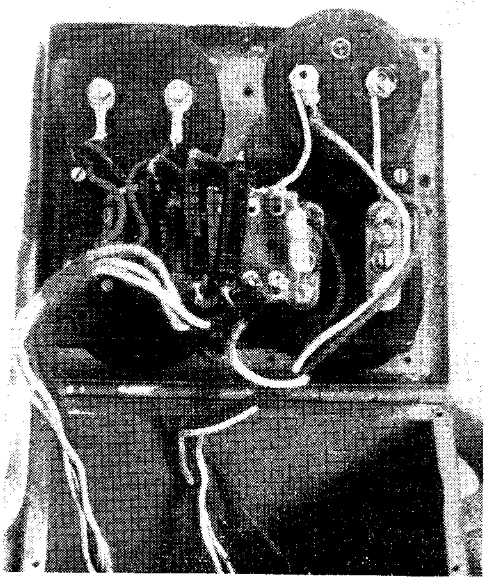


Fig. 4. Underside of meter board, showing half the original ebonite panel retained for the plug-in meters, and the resistances mounted on a tag board

say, by making an 0 to 60 V range ; nor should the multiplying factor be more than 2, otherwise considerable inaccuracies are likely to result. The temptation must be resisted, as it is here that the friend with the expensive test set is required. The ammeters were, of course, used unmodified. Fig. 1 shows the circuit diagram of the complete instrument.

The aerial coupling unit was stripped down and the parts retained were the horizontal steel panel which fixes to the case by eight 6-B.A. screws, an ebonite panel, and its spacers, by which it was spaced about one inch from the underside of the metal panel. The ebonite had the sockets for the plug-in meter fixed to it. As the moving-coil meter was of the same plug-in-type, two sockets for this were fixed to the ebonite alongside the original pair. The new sockets were made from flanged bushes recovered from the coil assembly and secured to the ebonite by 7-B.A. screws, three in each. The ebonite was then cut

in half to allow room for the other meters which were flange mounting. Holes were cut in the metal panel for the four meters. Fig. 4 illustrates the back of the final assembly with the resistances mounted on a tag board.

The sockets for the test leads consisted of two chassis-type 5-pin British valve-holders bolted to the front face of the case. The advantage of this holder is that the outside sockets are equidistant from the centre one. This was discovered quite by chance and it was realised that, if the centre socket were used as the common connection of several ranges, a two-pin plug could be used instead of the usual two loose plugs on the test leads. A search in the junk-box produced an R.A.F. camera plug 5c/590 and socket 5c/457 having exactly the right spacing of $\frac{5}{16}$ in. between the pin centres. The plug had pins which were recessed and, therefore, unsuitable for insertion in the valve-holders, but by removing the pins from the plug body and mounting them in place of the metal sockets in the 5c/457 body a suitable two-pin plug was produced. A little work with a scriber and white ink produced neat + and – marking on the ebonite body. This is shown in Fig. 5, which illustrates the completed job. The leads from the two-pin plug were terminated by black and red radio type single split plugs to which can be attached either crocodile clips or test prods. The test prods were made from available material, namely $\frac{3}{4}$ in. lengths of tubing attached to 2 in. lengths of 6-B.A. rod. Suitable sleeving was pushed over each prod to cover all except $\frac{1}{8}$ in. at the end.

The making of this instrument has tidied up and increased the usefulness of a few loose meters, and although the accuracy of the individual meter cannot compare with the expensive Grade "1" multi-meter, it is sufficient for normal testing purposes where precise measurements are not required.

A final word on surplus meters generally: make sure the meter will work properly in the plane in which it will be used, be it horizontal or vertical. Also, if a movement tends to stick at certain points of the scale, don't maltreat it, but take it from its case carefully and ascertain the cause, which will probably be slight corosion or a flaking of the enamel due to the course of time. A gentle stroking with a camel haired brush will remove the offending particles. This applies particularly to the moving-iron type where the clearance for the "iron" is very small and the "iron," of course, is painted or otherwise coated. Flaking of the coating will cause the trouble mentioned. A few minutes thus spent may well repair an otherwise useless meter.

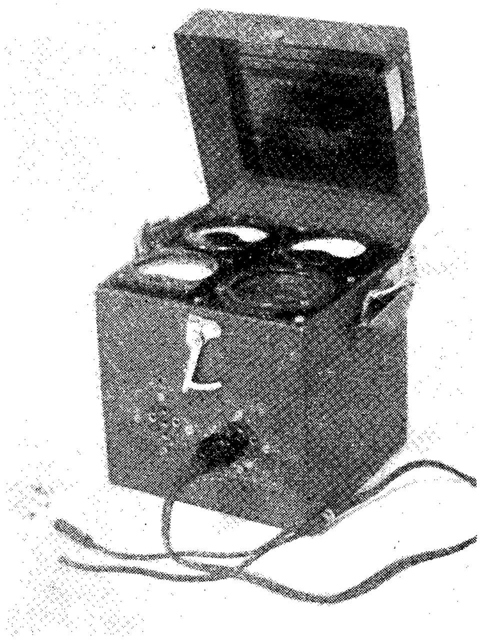


Fig. 5. The completed instrument with test leads, crocodile clips and prods

Petrol Engine Topics

(*Continued from page* 541)

worse!—"It will never be seen!" It is only by taking care even in the *apparently* insignificant details which don't seem to matter, that one acquires the *habit* of accuracy so essential to good craftsmanship. And so often it happens that these details do matter—a great deal more than one thinks!

The holes in the flange must be countersunk deeply enough to ensure that the screw heads cannot possibly project above the surface when fully home, as this would upset the seating of the magneto backplate when fitted in position. It is better to err on the side of sinking them too deep than otherwise. Note that when the magneto is fitted, the two screws or studs which secure the backplate will be tapped into the lugs of the mounting flange, but no details of the tapped holes are shown, in case a different type of magneto is used.

(*To be continued*)

A FLEXIBLE GRINDER

by A. D. Stubbs

MY tool-sharpening carborundum wheel is mounted about a foot away from the lathe tailstock, and is driven by a countershaft from the lathe motor, at 5,000 r.p.m. I toyed with the idea of adapting this for use on the lathe, but eventually decided in favour of this flexible grinder, which has been very successful in operation. One of the jobs which it undertook was taking off the final 0.002 in. of the reduced end of the piston-rods of my "Three-cylinder" electric motor ("M.E.," April 5th and 12th, 1951).

On the end of my motor pulley is a vee-pulley, turned from ¼-in. steel plate, 7½ in. diameter, with a centre rebate to register on the end of the pulley. Three set-screws at 120 deg. fix it. This gives me about 6,500 r.p.m. on the grinder. These little wheels should not be run under 5,000 revs, and for safety sake they should be guarded, but I have to admit having dispensed with that formality.

Fig. 1 illustrates the input end. The pulley is 1½ in. P.C.D., of steel ⅜ in. thick, the vee being $\frac{5}{16}$ in. wide at the periphery, tapered at 40 deg. included angle for a depth of ¼ in. This is screwed $\frac{5}{16}$ in. cycle thread. Before you get under way with any of the components it would be well to acquire the cycle parts, flexible drive cable and the tube, because they will determine some of the dimensions. For example, there are both ⅜-in. and $\frac{5}{16}$-in. cycle hubs. I chose the $\frac{5}{16}$ in. size, which provided the driver spindle. Hubs of varying manufactures are not all the same diameter, neither are the cup bearings all similarly carried in the hubs.

Fig. 2 shows the business end of the job, for which I made a special holder. It is rather heavy, and if I made another I should, given the same bearings, use 1⅛ in. square steel, and screw the round portion the equivalent to $\frac{15}{16}$ in. pipe thread, were there one. (I'll start a B.S.S. of my own !) On the other hand, I have an idea that I should use cycle pedal bearings, and so still further reduce the diameter and weight, but they may be a trifle too light for the job.

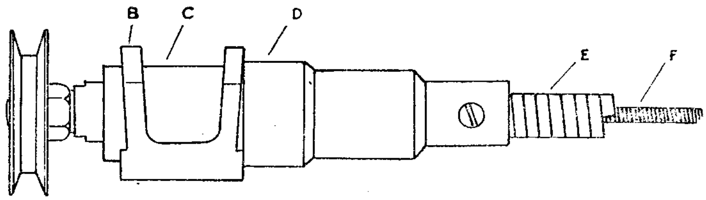


FIG. 1. DRIVER ASSEMBLY.

The flexible part of the grinder, lettered *E* and *F*, were just too easy, in fact, the whole grinder evolved from the tube *E*. One day our flexible tube to the gas lighter started to leak, so I bought another. The old one no doubt deserved superannuation, which is just too bad, because in the grinder I hope that it will have many years of useful life. For the driving cable, I set out to obtain a discarded motor-cycle clutch wire, but ended up by scrounging a scrap car speedometer cable from the garage round the corner. The two ends of this were dissimilar, and as the cables are scrapped when one end goes, the end which you acquire may be the one missing on mine.

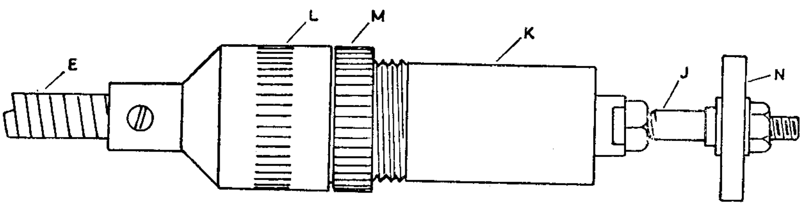


FIG. 2. DRIVEN ASSEMBLY.

To hold the Fig. 1 assembly I wanted a bracket. Once upon a time a dearly beloved feminine relative gave me a vice as a birthday present. It was enamelled a beautiful blue. *Was* is the correct tense, too; because being of cast-iron it soon became a thing of the past, but the broken slide became my bracket, *B*, (Figs. 1 and 3). A piece of channel steel, or two angles, would serve equally well, but check your hub diameter before boring the hole.

Some cycle hubs have a reduced diameter between the bearing housings. Mine was parallel,

so by cutting off both of the flanges which carry the cycle spokes, I obtained a 2 in. length of tube, part *C*, (Fig. 1), into which the cups of the ball-bearings were pressed.

The holder, *D*, (Fig. 4), is a push fit on the tube, and was turned from solid steel, the screwing of

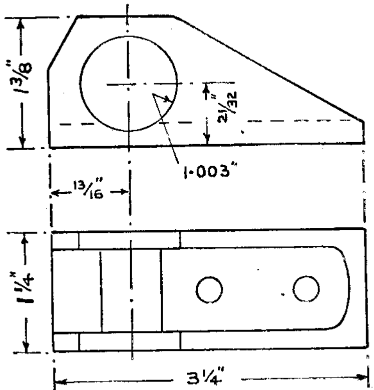


FIG. 3. BRACKET B.

one end 4½ t.p.i. to match the flexible tube being quite an interesting job. To prevent rotation of the tube a Meccano 5/32-in. Whitworth set-screw was used.

On the end of the speedometer cable I had a square spigot, *F*, (Fig. 5), so made a union nut, *G*, to accept the round backplate, the nut being screwed $\frac{5}{16}$ in. cycle thread for the spindle. In the spindle itself a slot was cut to accept the spigot, and the whole is accommodated within the holder.

A Try-out

Having got as far as that, of course I had to try it out, so temporarily laid out the flexible cable and tube in a straight line, prepared for anything and everything, and put on the power. There were no complaints, in fact, a " dynamo-

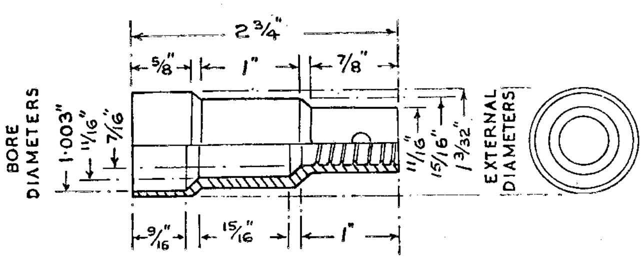


FIG. 4. HOLDER D.

meter " test of holding the spinning cable between two pieces of wood showed that I could safely complete the job. Perhaps I might mention here that *C* could revolve in *B*, and *D* could rotate over *C*, for neither is held against rotation, but as neither has ever evidenced the slightest indication of any desire so to do, I have left them alone.

Apart from the slot in the cycle driving spindle, it is cycle standard.

Fig. 6 illustrates the union nut, *H*, for the driven

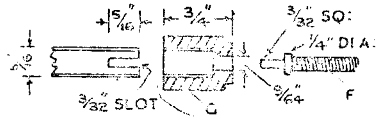


FIG. 5. SPINDLE ASSEMBLY.

unit. At this end I had a bare cable, precisely as shown protruding in Fig. 1, so this union was made with the intention of sweating the cable into the 9/64 in. hole. However, when experimentally set up, with the cable end splayed out and gripped by the spindle end, I had a perfect drive. When overloaded, the cable slips here, and is quite probably causing a little wear on the union, but I am leaving it as the weakest link in the chain, knowing that I can always sweat it in if necessary.

For spindle *J*, cycle components were not long enough unless I restricted the distance between bearings. Anyway, the standard arbors

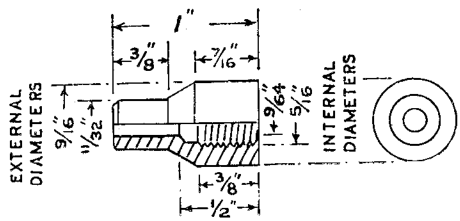


FIG. 6. UNION H.

for carborundum wheels are ¼ in. with ⅜-in. shoulders, so I used ⅜-in. silver-steel for *J*. This must, of course, be dead true turning and screwing throughout. The apparently surplus thread on the end (Fig. 2) is necessary for other wheels. I have one 1½ in. diameter, ¼ in. wide, as shown, and another ¾ in. diameter, ½ in. wide. So far, these two have undertaken all the jobs I have met.

In Fig. 7 I show below the spindle all the components in the order of assembly. When putting them together, the cable end is locked up, which gives adjustment on the outboard end of the $\frac{5}{16}$ in. cycle thread.

Fig. 8 shows the holder *K* just as I made it, from 1¾-in. round black steel, but I certainly recommend that it should be reduced. This, in turn, would enable you to reduce the diameter of cap *L* (Fig. 9), and the ring *M* (not detailed in my sketches). Both the cap and the ring were knurled, and the thread adjustment was incorporated because I did not know what the reaction of the cable would be. I have tried it slack, and

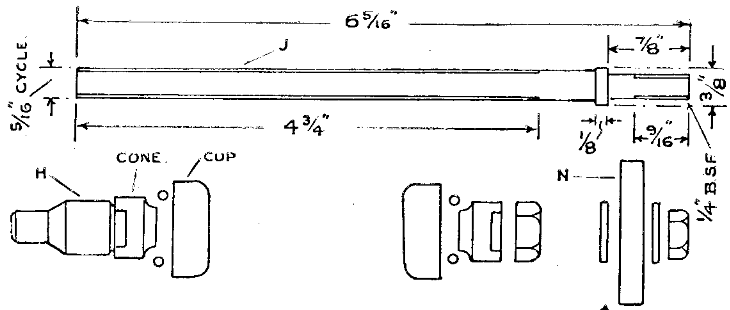


FIG. 7. DRIVEN SPINDLE ASSEMBLY.

I have tried it tight, but nothing untoward has happened.

Before final assembly I packed the flexible tube with grease, and periodically a little more has been added from the driven end. The speedometer cable tends to wind the grease down than 180 deg. out of a straight line, but I have turned it through more than 360 deg. and it does not warm up or show any signs of distress.

Just one word of warning to my less experienced readers. Carborundum dust on the lathe bed

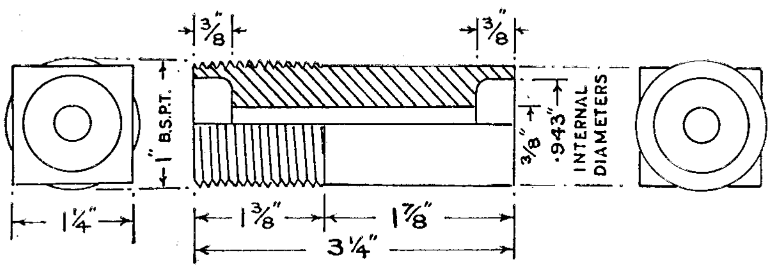


FIG. 8. HOLDER K.

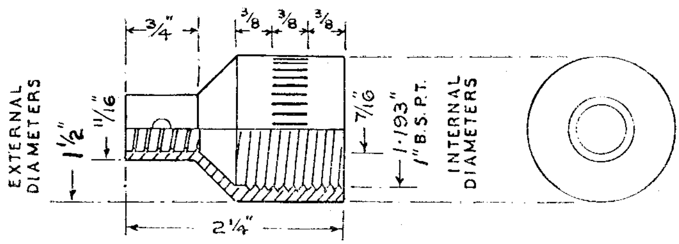


FIG. 9. CAP L

to the driver. Which reminds me that it is essential for the grinder to be driven clockwise when looking on the vee-pulley. Rotation the other way would unscrew the pulley and unions and probably the carborundum wheel as well.

In operation, the square of the holder *K* is gripped in the tool holder or on the cross-slide, oriented as desired, either in front of or behind the work. I make a point of never using it more will very quickly play havoc. If possible, catch the dust before it reaches the lathe. I often use a sheet of paper, loaded down on the top-slide with a spanner. If the edge of the paper fouls the work or the faceplate, it is knocked away harmlessly. Even with this precaution, I always clean down the lathe thoroughly after grinding.

My next job is a chuck to enable me to hold the standard range of carborundum and file rotary tools with fixed arbors.

Novices' Corner

Notes on Countersinking

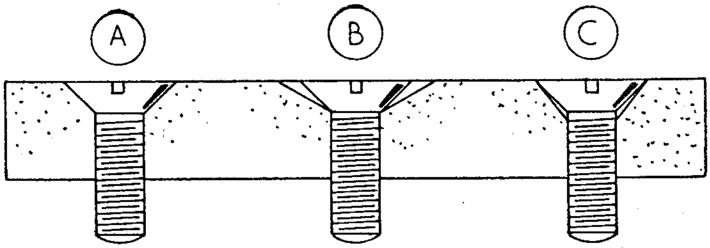


Fig. 1. "A"—a well-fitting countersink; "B"—the countersink angle too wide; "C"—the screw-head bears on the mouth of the hole

HOLES drilled in metal are, perhaps, most commonly countersunk to allow the heads of screws to lie flush with the work surface. As countersunk screws of standard pattern have the coned head formed to an included angle of 90°, the depression made by countersinking should be machined to correspond by employing a 90° countersink in order to give the appearance illustrated in Fig. 1A. Should the depression,

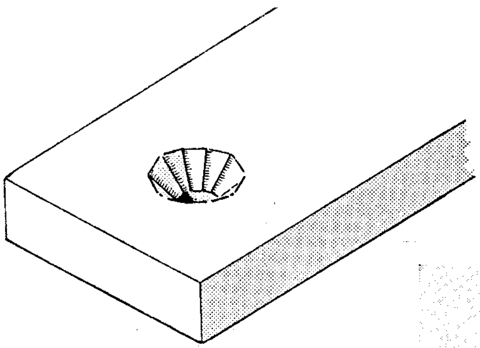


Fig. 2. Irregular countersinking caused by chatter

however, be formed to a greater angle, as in Fig. 2B, an unsightly gap will be left between the edge of the screwhead and the work. It is better, therefore, to make the angle of countersinking, if anything, slightly less than a right-angle so that, as represented in Fig. 1C, a good appearance is obtained.

The chief difficulty in countersinking is to form a smooth, well-finished surface free from chatter marks, for, when the countersink is mounted in a small drilling machine and driven at moderately high speed, chatter is often hard to avoid and there may be no certainty of forming a truly coned hole; sometimes the work may even have the appearance shown in Fig. 2. However, where a robust type of drilling machine with well-fitting bearings is used, and the work is firmly secured to the machine table, the ordinary forms of commercial countersinks, shown in Fig. 3A and C, will cut cleanly if run at moderate speed. But, as a rule, conditions are less favourable; the drilling machine is of light construction and its bearings may be worn: the drilling speed is too high: and the work is held with the hand.

Nevertheless, these difficulties can largely be overcome by using a countersink of suitable form. Two examples of countersinks that have but little tendency to chatter at once come to mind, namely, the centre drill and the ordinary twist drill.

The coned end of a centre drill is formed to an angle of 60° to correspond with the coned lathe centres and so is hardly fitted for use with countersunk-head screws. A twist drill, however, has its point ground to an angle of 118° for ordinary use, but if, as illustrated in Fig. 4, this angle is reduced to 90°, an efficient countersink

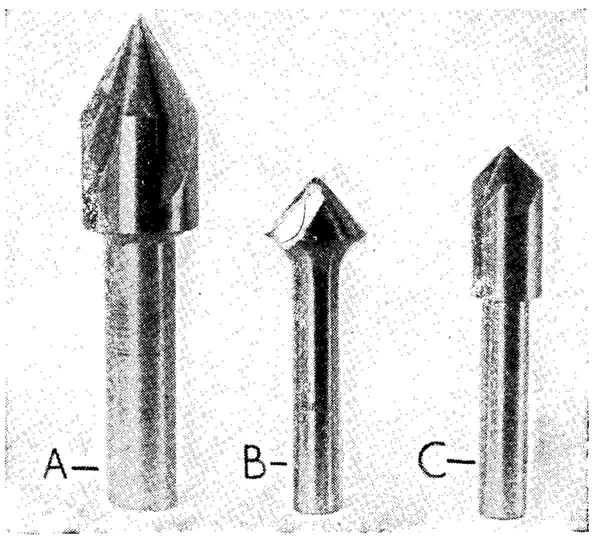


Fig. 3. "A" and "C"—countersinks with four and five cutting lips; "B"—two-lipped countersink

will be made, although chatter and irregular machining may occur where the hole being countersunk is of large diameter and so offers but little support to the drill point.

Nevertheless, this trouble can be avoided by first drilling a pilot hole, which is then countersunk and afterwards enlarged to the full diameter required to clear the screw shank.

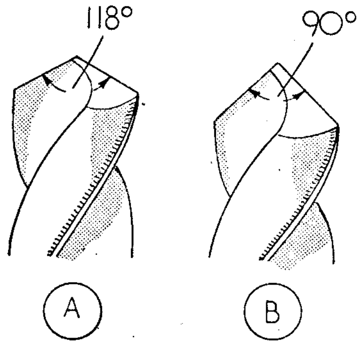


Fig. 4. "A"—standard twist drill; "B"—the drill reground as a countersink

To adapt a twist drill in this way, the point is ground free-hand on the grinding wheel, for the ordinary twist drill ginding-jig will form the point only to the standard angle. The drill lips are ground with reference to a 45° gauge or a protractor, and they must be made of equal length; at the same time, rather less than the normal amount of back-off or clearance should be given, as this will help to prevent chatter and any tendency for the drill to dig-in. In the small workshop, successful countersinking is largely dependent on giving sufficient guidance and support to the tool point by keeping the clearance angle small, so that only a thin, but regular, shaving can be taken by the cutting edge.

A Simple Countersink

The Goodell-Pratt pattern of two-lipped countersink, shown in Fig. 3B, is ground in this way and gives good results if run at slow or moderate speed and well supplied with cutting oil when machining steel. As there may be some difficulty in obtaining countersinks of this type at the present time, and as an alternative to the modified form of twist drill, the tool illustrated in Fig. 5 can easily be made in the workshop from a length of silver-steel of, say, ⅝ in. diameter. This simple type of countersink is quite free from any tendency to chatter or to form an irregular hole; moreover, as shown in the illustration, it cuts a continuous, ribbon-like shaving and leaves a smooth surface on the work. In shape, the cutter resembles a D-bit, but has the cutting edge formed at an angle of 45 deg., that is to say, the round material used is cut away at the point exactly as far as the centre-line. This countersink has, of course, only one cutting edge, and the remainder of the tip acts as a guide to steady the tool when cutting; this enables holes of large diameter to be countersunk without danger of the tool grabbing or digging into the work—an action which the Americans aptly term hogging. The steel work-piece illustrated was machined with the cutter running at 200 r.p.m., and at 400 r.p.m.

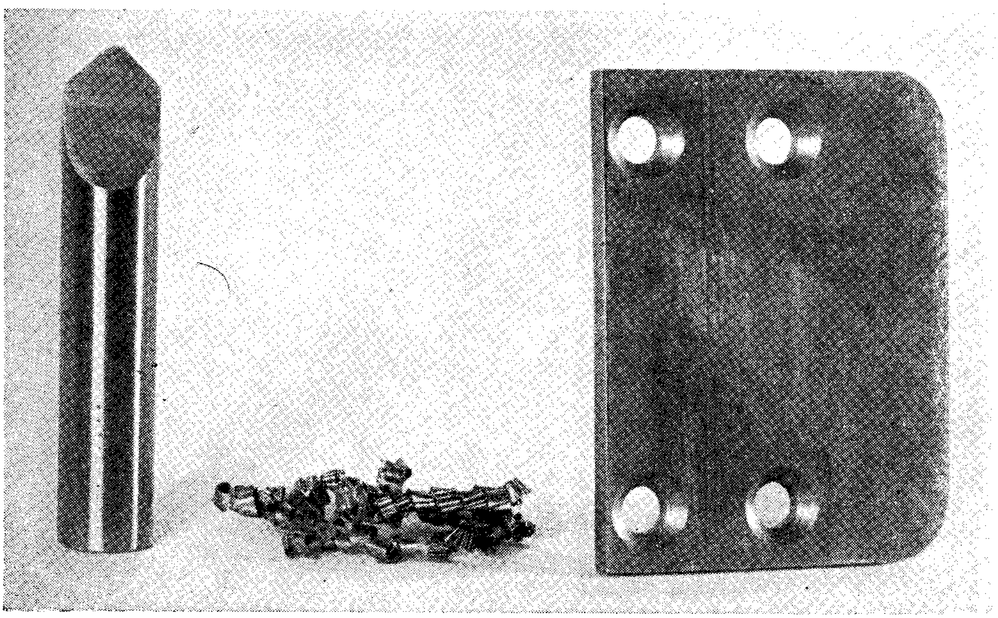


Fig. 5. The D-form countersink cuts a coiled chip and forms a well-finished hole

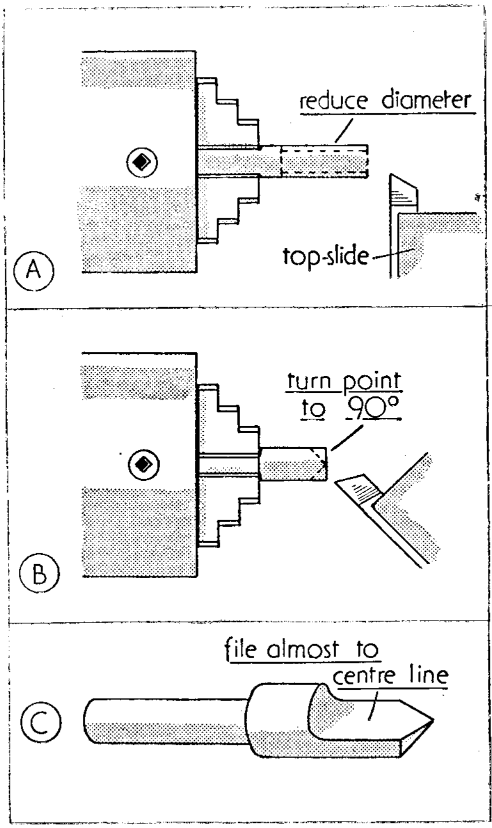


Fig. 6

the tool still cut cleanly, although the shavings did not then form continuous coils. Brass can be machined at a higher speed and a good finish obtained.

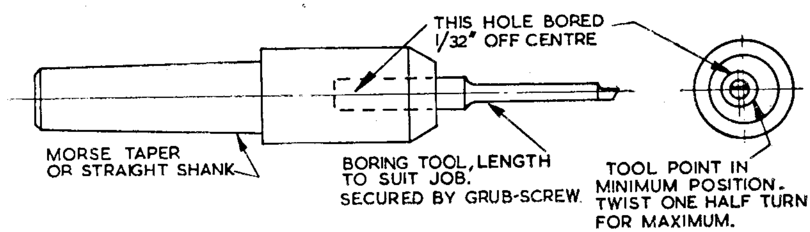
Making the Countersink

To make the countersink, a length of ⅜ in. diameter carbon-steel, such as silver-steel, is used, and if the drilling machine chuck will not grip this diameter, the shank is reduced to, say, ¼ in. diameter with the material set to run truly in the four-jaw chuck, Fig. 6A. The work is next reversed in the chuck, and again set to run truly, so that the tip can be turned to an included angle of 90° by setting over the lathe top-slide to an angle of 45°, Fig. 6B. There is no need to machine the tip to a sharp point, but a small, central pip should be left to act as a guide when filing down to the diameter line. After the point has been machined to a good finish, the work is gripped in the bench vice and the tip is flattened by filing to within a few thousandths of an inch of the exact centre-line. The filing should be carried for a short distance beyond the base of the coned portion, and the flat is formed with a hollow curvature at its upper end, Fig. 6C.

All burrs caused by filing are carefully removed with a fine file and oilstone slip. After the cutter has been hardened by heating it to a bright-red and plunging it vertically into cold water, the surface is cleaned with a strip of worn, abrasive cloth. The tool is then tempered by heating the end of the shank until a pale-straw tint reaches the tip, and then again quenching in water. Finally, the cutting edge is sharpened by oilstoning the flat face to bring the cutting edge to lie almost exactly on the diameter line. Although the countersink, can be resharpened in a similar manner, a tendency to chatter, when cutting, may develop once the cutting edge falls appreciably below the centre-line.

An Adjustable Boring Tool Holder

by R. L. Smith



THE need for an adjustable boring tool arose when I had some jig boring to do with the work bolted on the lathe boring table, no other means being available; but it can be used on any other job where "snout boring" is necessary.

It can be made in any size, mine being 1 in. dia. with a No. 2 Morse taper to fit the headstock.

The tool consists of two parts only: the body and holder, and the boring tool itself. In operation, the cut is increased by twisting the tool, and fairly fine adjustment is possible, half a revolution being needed to increase the cut $\frac{1}{16}$ in. Half a revolution increases the cut from minimum to maximum, of course.

The sketch is, I think, self-explanatory.

A Model Steam-Driven Electric Generating Set

by E. G. Uphill

EVER since 1907, when I started to read THE MODEL ENGINEER, one of my ambitions has been to make a model of a steam-driven electric generating set. Having finished my $3\frac{1}{2}$ in. gauge 0-6-0 tank locomotive, I saw advertised, by friend Kennion, a set of mill engine castings. These were found to be very good castings, and it was not long before the engine was finished. Just about this time, " L.B.S.C." published the details of a vertical boiler for testing purposes. It was decided that this was just the boiler for the job of driving the engine. The copper tubes for the barrel and firebox were purchased ; as these were a quarter inch larger than the sizes given, two inches was added to the length ; 48 fire-tubes $\frac{3}{8}$ in. diameter and one superheater tube 1 in. in diameter were fitted, and the whole lot went together without any snags. The idea of lifting the boiler to clear the fire did not appeal to me, so two 5/32 in. rods were passed through holes so that the fire-bars could be dropped and would pass through a hole in the baseboard right into a galvanised steel ash pan screwed underneath. All the fittings were made following the usual " L.B.S.C." practice, with the exception of the pressure gauge and injector. The water tower, which could not be kept to anything like scale size, was made from 20-gauge galvanised sheet mounted on angle supports, and feeds the injector. A coal bunker made from the same metal was fitted below. Provision was made on the boiler for pumping in air to start the fire.

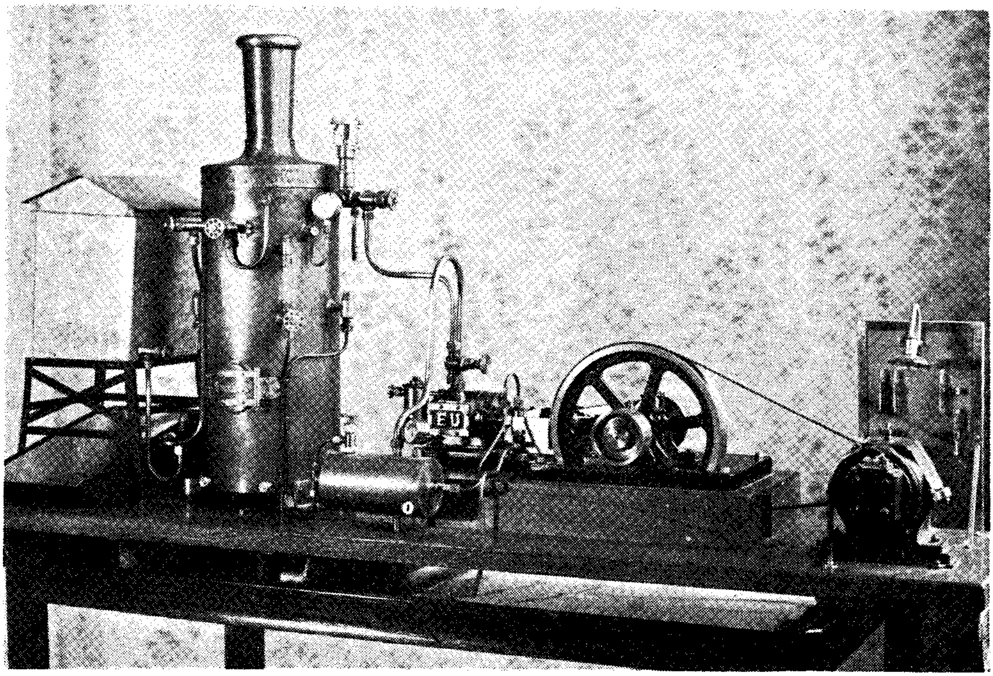


Photo by] [*Norman Dyer*

When all was ready, it was only a matter of minutes before the safety-valve was blowing at 80 lb. ; from then it never closed down and the fire was dropped ! Upon inspection, it was found that the superheater must have been red-hot, and the very hot steam had collapsed the safety-valve spring. The valve was altered, the spring fitted outside the valve and this has given no trouble since.

The electric generator was once a tachometer, purchased for the sum of 5s. from a Middlesbrough firm advertising in THE MODEL ENGINEER. This was doctored to make it look something like an enclosed type dynamo—bits sawn off and bits put on. The old flexible drive was removed and a new one fitted, and a pulley for a flat belt made and fitted. When all was ready

six 2-volt lamps were wired up in parallel; low-voltage lamps were chosen because the plant was to be a slow-running job. When steam was raised and the engine running at what was thought to be the proper speed, the switch was pushed home and there was a wonderful blaze of electric light from the six lamps, but only for about half a second—they had gone the way of all electric bulbs! After this, 8-volt lamps were tried out, and it was found that four of these could be brilliantly lit with the engine just ticking over fast enough to keep it running steady.

The model works well on 40 lb. of steam, but I have yet to find an injector that will work on this pressure. The pump on the engine draws water from a tray under the baseboard and pumps it through a coil inside the condenser, warming it before it goes to the boiler, or it can be by-passed by a valve, and is sprayed into the condenser, keeping it cool. An outlet from the condenser passes through the baseboard into a tray.

The model gave me a deal of pleasure in the making and I hope it will give pleasure to many in the future. Anyway, it's another ambition fulfilled.

PRACTICAL LETTERS

Motorising the Mower

DEAR SIR,—May I enter a word of protest at Mr. A. D. Stubbs's suggestion of earthing the neutral lead of company's supply mains, especially in the manner suggested in his drawings of the motorised mower.

It is quite true that the neutral is already earthed, but it is earthed at a company's distribution point, which may be some distance from the consumer's premises. It is possible, therefore, particularly in these days of overloaded distribution systems, that the neutral may at the consumer's premises be at an appreciably different potential from earth. The order of this potential is not very high but 4 or 5 volts is quite common, and I have once met a house where 15 volts was sometimes recorded. The effect, therefore, of earthing the neutral in the consumer's premises will be for a current to flow from neutral to earth, and although the voltage will be low, the resistance of this circuit will also be very low (dependant on the quality of the earth) and the current, therefore, may be very considerable, sufficient possibly to blow the neutral fuse in the consumer's circuit. The result of this is potentially dangerous.

As an illustration of what might happen There might be an appliance of heavy load connected in some other part of the premises, but this will continue to work taking its return *via* the neutral lead to the point at which this is earthed, and thence *via* the earth lead, so that there will be no obvious indication of the blowing of the neutral fuse. If now this earth lead should become disconnected (unlikely perhaps, but accidents do happen) then the framework of the mower will be left live owing to the connection of the neutral to its frame; the neutral itself now being live *via* the other appliances in the house.

If, at the moment this happened, Mr. Stubbs were to be standing in a pair of nailed boots on wet ground holding firmly on to the metal frame of the mower, then perhaps he would be so good as to take my word for it—he would be very very dead.

Yours faithfully,

Chistlehurst. H. GLYN JONES, M.B.E.

Camera Construction

DEAR SIR,—The home-construction of miniature cameras, is a subject in which I have long been interested. I recently completed a "mock-up," using a cut-down 3½-in. × 2½-in. reflex camera body, a roll-film adapter, further adapted for 35 mm. film, and an old full-size cine camera lens of about four inches focal length. While the results are promising, the whole thing is bulky and unhandy. So I welcome Mr. Gunter's suggestion of a design for a miniature that could be made by the average reader. If successful designs for cine and still projectors can be evolved, a "Model Engineer" camera should be easy.

I agree that a focal-plane shutter is essential to take advantage of available lenses, and also to cut out what would be the most exacting job, i.e. the making of a focussing mount, since most of the shutterless lenses have their own focussing mounts.

Perhaps I may crave a few inches of your space to offer some ideas based on a project of my own, using various parts which I have collected. I propose a shutter of the kind having a single blind with a number of slits of different widths; I have the winding and release mechanism for this, *ex* an old "Graflex." The mechanism is arranged to arrest the blind after one slit only has passed in front of the film, and would be very easy to make. But since this kind of shutter is not self-capping, I propose to provide a light-tight flap covering the opening in the plate behind which the blind works, normally held closed by a spring, but opened immediately before and during exposure. The opening mechanism would preferably be linked to the shutter release, but I have not so far worked out a detailed arrangement for this. For the lower (spring) roller, I have to hand a spring roller from an old before-lens roller blind shutter, complete with variable tension device. This again is of quite simple construction.

As regards the general layout, it is clear that to arrange the film-casette, counting mechanism, take-up spool, two shutter rollers, and the film frame opening all in one general plane, as is usual in commercial cameras, leads to a long narrow body, of somewhat awkward shape, only really

convenient for horizontal pictures, which I find, on analysis, to be much less used than verticals. I propose, therefore, to make the body more adapted for normal use in an upright position, and to make it deeper from front to rear, than the orthodox miniature, by arranging the shutter rollers in the front part, with the casette, take-up spool and counting sprocket lying behind the shutter rollers and film frame in a separate back part, detachable, or hinged for loading. The focal plane would come more or less on the plane of the joint between the two parts. With this arrangement, the film would have to be wound in the casette with the emulsion side outwards. Since, however, an enthusiast economically minded enough to make his own camera would load his own casettes with refils or from bulk film, this would be no disadvantage.

The film transport, counting and rewinding mechanism, pressure plate, etc., do not present much difficulty. In a published design several alternatives, simpler or more elaborate, might be given, e.g., the rewind might be omitted.

The main body, I propose to use, is about 2¼ in. wide by 4 in. high, and under 2 in. from front to rear. This latter dimension could be, and might have to be, reduced for short focus lenses. I do not, however, propose to use any lens of less than 3 in. focal length.

The rear part of the body need not be much over 1 in. from front to rear to take the casette, film spool, etc. If any reader is interested, I should be glad to elaborate details, but I fear that a descriptive article would not be of general interest at this stage.

Yours sincerely,
Sunbury-on-Thames. A. C. HIGGS.

Effects of Refrigerants on Aluminium

DEAR SIR,—As a refrigeration workshop engineer, I have read with very great interest all the articles and letters appertaining to domestic refrigerator making, and think that most ideas compare well with standard practice in this industry ; but, however, referring to Mr. Dunn's letter upon the action of Freon on aluminium, I cannot agree.

Freon 12 (dichlorodifluoromethane), most commonly used in modern refrigeration, can be used in a system where aluminium is present without any ill consequences. The only time that Freon will attack aluminium, is when methyl alcohol is added to the system as a dehydrating agent, in such systems calcium chloride, enclosed in fine mesh filters, should be used.

Freon is well known to be a very searching refrigerant, and leaks a little tiresome to overcome, but is well worth perfecting your equipment to use. Its qualities are as follows : Boiling point —22 deg. F., odourless gas and liquid stable up to 1,022 deg. F., it is four times heavier than air, non-inflammable, non-explosive and non-corrosive. Freon mixes with mineral oils in all proportions.

It is advisable not use methyl chloride or SO_2 where aluminium is present, as corrosion would take place under certain conditions.

As mentioned before, methyl alcohol can be used as a dehydrating agent with Freon in a normal system, added at the rate of 5 c.c. per lb. of refrigerant, this can be used with no other gas but Freon.

This information is given from practical experience, where a hermetically sealed unit was opened up, and the aluminium rotor which had run in Freon and oil for a number of years was found perfectly intact.

Hoping this information will be of some use to a constructor.

Yours faithfully,
Leicester. JAMES R. COATON.

Auto-transformers

DEAR SIR,—I was interested to read the article on the above subject in the March 15th issue. J. W. Cooper has, however, failed to appreciate one fundamental fact which gives the auto-transformer its main advantage, in certain circumstances, over transformers whose windings are separate. This is that the secondary current in any transformer is 180° out of phase with that of the primary. It follows that the current in the common winding of an auto-transformer is not the sum of the primary and secondary currents, but their difference. Auto-transformers are thus most economical when small changes of voltage are needed. For example, suppose one needs to drop the mains voltage from 200 to 190 and to handle one kilowatt. The primary current is 5 amps, and that of the secondary 5.21 amps. The common winding, i.e. 95 per cent of the whole, need be wound with wire of a gauge sufficient to pass only $5.21 - 5 = 0.21$ amps.—not 10.21 amps. The remaining 5 per cent. of the winding will, of course, have to carry 5 amps. The economy of wire, and winding space is thus considerable.

It is felt that the safety of auto-transformers should not be over-stressed as, should the common winding burn out, the full mains voltage will appear across the secondary. This, in the case of large ratio auto-transformers, may well be dangerous both to apparatus and life.

Yours faithfully,
Upper Norwood. Dr. R. PARFITT.

DEAR SIR,—I have to thank Dr. Parfitt, and others for having kindly pointed out an error in my article on auto-transformers. I should have made it clear that the current carried by the secondary is the difference between the primary and secondary currents. So far as the safety of the auto-transformer is concerned, it would differ little from the normal transformer not provided with an earth screen or an earthed secondary. The point is stressed that no connections should be carried out while the transformer is alive. Referring to the transformer design given, I would say the data furnished is taken from a worked design, the transformer being used to replace a line cord of a radio set ; over a period of years this transformer has given satisfactory service.

Yours faithfully,
Enfield. J. W. COOPER.

Simpson's Day, 1935

DEAR SIR,—In the article by "1121" in a recent issue of THE MODEL ENGINEER—he states that no records were kept of the memorable occasion of Simpson's Day, June 29th, 1935—which was published in THE MODEL ENGINEER on August 1st, 1935.

Both Wood-Mason and I did 212 laps—his engine being a two-cylinder as against mine with three-cylinders—which naturally meant my using more water and coal. I remember at the time, as the water in my boiler was running low, I should have been glad if I could have got all the drops of perspiration into my tender, I might have held on!! Still, $8\frac{1}{2}$ miles on the gallon of water and $\frac{3}{4}$ lb. of coal—after our locomotives had been prepared for the road—is not a bad test both of driving and performance of the locomotives concerned, and I still have my screw-driver!!

There was one man who drove my locomotive at several M.E. exhibitions, who got more out of my locomotive than I ever could. He was a very sympathetic driver and I think my locomotive, like a good horse, understood the driver!

Yours sincerely,

London, N.12. G. H. W. RANDELL.

Lapping Materials

DEAR SIR,—Having to revive some long-forgotten lore recently when faced, on the farm, thirty-five odd miles from supplies, with dealing with a distorted fuel pump top-plate and a leaking two-way petrol tap on my Dodge truck, it occurred to me that some of your younger readers might not be aware of the merits of Vim and Brasso as lapping materials on alloys and brasses.

As with all lapping, the jobs took time and care, but a twist in the fuel-pump sump seating estimated at $\frac{1}{16}$ in. was scraped out, using wet Vim for marking, then the sump lip was lapped by hand to a finished polished fit with a Vim paste.

The residual twist in the top-plate covering the pump, and the pump lip were lapped out on glass with Vim and the pump fed air on test before fitting new gaskets, that for the pump being cut from bitumen-cored paper for want of sheet cork thin enough, by the old method of tapping gently with the ball face of a 2 oz. ball-paned hammer and producing a perfect gasket.

The leaking tap was lapped in, from no contact at all at one vent to a finished smooth non-jamming fit, by roughing out with Vim and finishing with Brasso, but imparting a 25/35° swing to the plug held in the jaws of a breast drill, lifting the cock body clear frequently and opposing new faces at intervals by one complete turn on the breast drill handle.

The finish on the plug is such that under its own spring pressure (and it is original equipment on a 1940 truck) the application of 30 lb. pressure to each tank in turn failed to bleed the tap.

As I say, reviving old lore, even had I had other materials at hand, Vim for the first, and Vim and Brasso for the second would still have been my choice, and being in a very hilly district any rise starved the pump and stopped the truck, so that I had to get myself out of my own difficulties, I remembered the saying of an old automobile engineer, many years ago: "There is nothing in the world so immobile as a car that won't go," led me through the merits of proper lapping to address you so that you could pass on this letter to your readers.

Yours faithfully,

Iringa. A. C. CHRISTIE.

Gas Torches

DEAR SIR,—The reference to Ferguson Propane Gas torch in a recent issue of THE MODEL ENGINEER, prompts me to make mention of the fact that British Oxygen Co. have for some years produced a variety of torches for use with air/acetylene.

These are in several sizes and types using low pressure and high, the former type being in four sizes a.c. 1, 2, 3, 4 for soldering and heating, and combining therewith 3 nozzles and a pair of soldering-irons which may be fitted thereto.

The high-pressure set HT No. 1, 2, 3 can be had with three heads, and is also in three sizes, the largest being about the same flame as a 5 pt. blow-lamp. Needless to say, I have no shares in B.O.C., but being a very satisfied user for the past four or five years it has often struck me as strange that no reference to these torches have appeared in THE MODEL ENGINEER. The first type mentioned, I use for silver-soldering of small fabricated jobs and for sweating up, though I haven't used the soldering-irons yet (nor probably ever will, preferring the old-fashioned 3-lb. iron), but for anyone fancying a self-heated job, they appear O.K.

Besides the larger H.T. sets, there are to be had Bunsen and H.T. bench blow-pipes, just similar to the old laboratory bunsen, only really hot stuff. Re this, my big torch literally screams and can be heard at least 150 yd. away. All these are very economical as regards consumption, and I wouldn't be without them as adjuncts to C.H. and D.H. welding sets.

Yours faithfully,

Penzance. HERBERT J. DYER.

Mechanical Aspect of Radio Control

DEAR SIR,—As a keen reader of your excellent magazine, I could not fail to notice an error which occurred in the article on this subject by A. M Colbridge in the issue of March 22nd.

Mr. Colbridge states that the current consumed by an actuator having a coil resistance of 8 ohms on 3 to 4.5 volts is 40-55 mA, and he later states that in the type of actuator employing a high resistance "hold in" coil, the current consumed will be 10 mA for a 100 Ω coil.

Reference to Ohm's Law $I = \frac{V}{R}$ where I = current in Amperes ; V = Volts ; R = Resistance will show that the actual current consumption in the three cases quoted will be 375 mA, 562.5 and 100 mA respectively.

This last figure is by no means a small drain for pen-cell batteries to supply, and the need for a much higher coil resistance is indicated.

I trust that these errors may be rectified, lest they cause confusion in the minds of those just embarking on this most fascinating hobby.

Yours sincerely,

Manchester. T. F. SUTTON.

Sec. Int. Radio Controlled Models Soc.